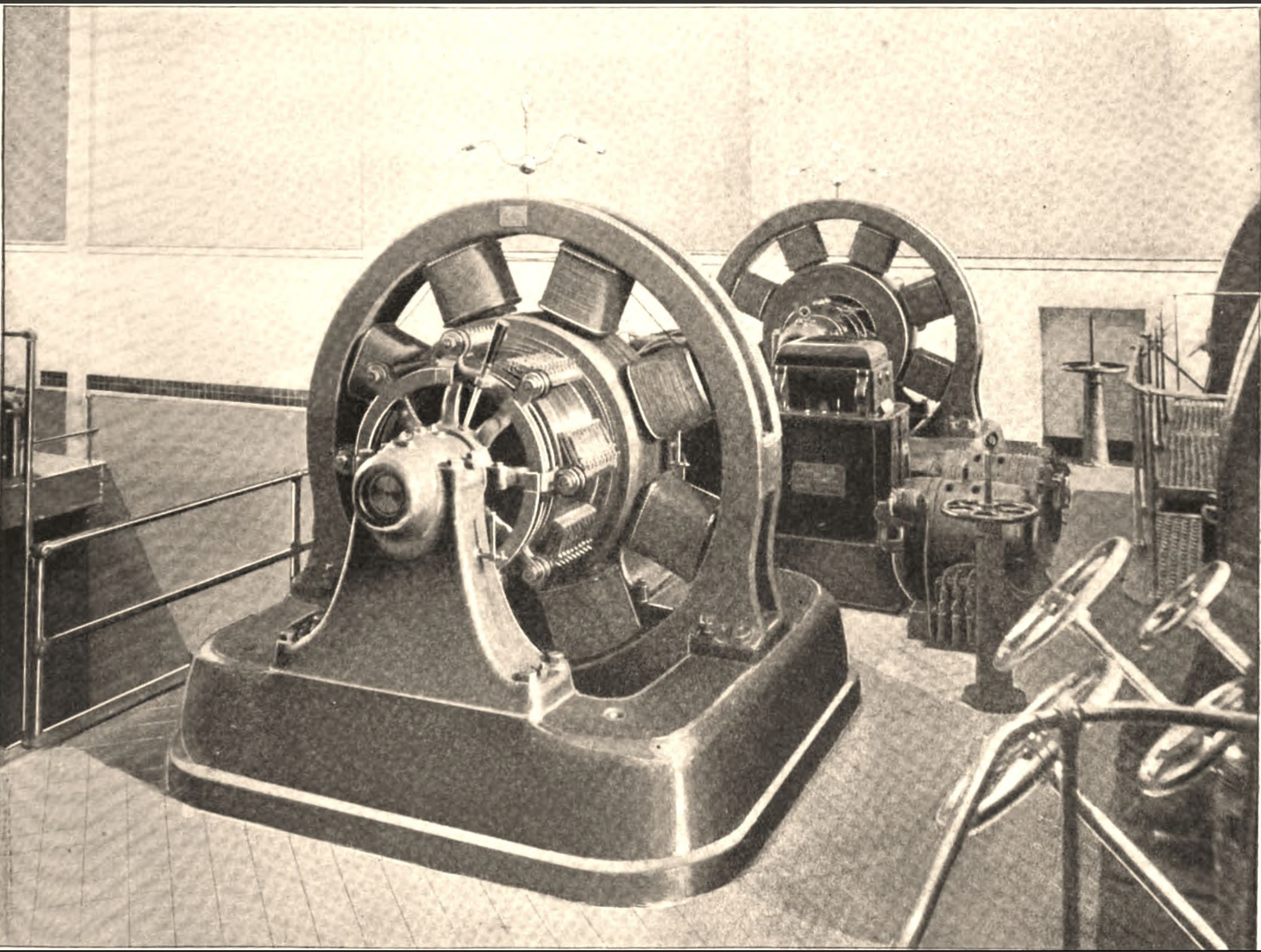

Electrical engineer


VASSOS

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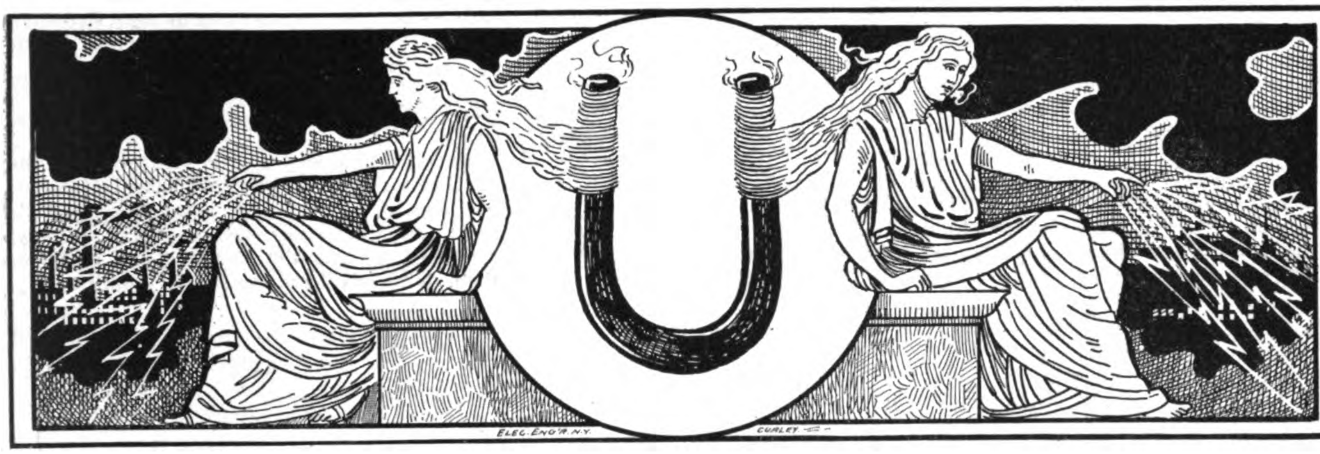
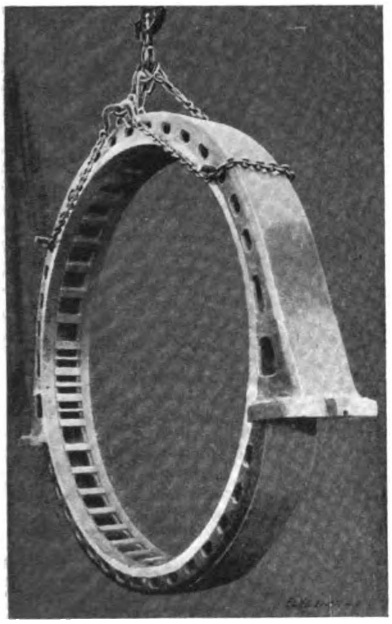


The Edison Electric Illuminating Co. of Brooklyn.—Its Development and Its Present and Future Work.

BY

Jos. Wetzler.

INTRODUCTORY



Armature Frame, 2,000 k. w. 3-phase Generator.

NWARD, ever onward, is the electrician's watch word. What was considered chimerical in electricity twenty-five years ago is now part of our daily experience. Indeed, less than twenty-five years have passed since men high in the scientific world demonstrated mathematically that Mr. Edison's incandescent lamps could never be operated commercially; and yet there are a hundred million such lamps in use and most of them burning nightly. When it comes to apparatus for generating and distributing electric current, even so short a period as ten years back seems a long time if one compares the apparatus and methods then in vogue with those of to-day. Yes, even five years ago the new Union Station of the Brooklyn Edison Co., would have been considered too great an innovation for serious contemplation, yet now we look upon it as just the thing and the electrical engineers of the whole country look upon Brooklyn as blazing the path of future progress in central station and electrical distribution work of every kind, whether it be for light or power, or other purposes.

It is not our intention, even if space permitted it, to go back to the electrical year 1, and trace the details of the great advances which have converted the end of the century into an electrical age; our object is a different one, and in its way, quite as interesting and instructive. For to us, the growth within the limits of a city, of an industry ministering to the comforts as well as to the necessities of its citizens, and destined to still further increase its sphere of usefulness, giving new employment to hundreds and even thousands and involving the investment of millions of dollars,—all this, seems to us a subject full of living interest, and the more so when the record of such an enterprise is one of constant, upward growth.

Such is the history of the Edison Electric Illuminating Co., of Brooklyn, whose work and equipment we propose to present to our readers in the following necessarily brief account—

THE NEW UNION STATION, FROM NEW YORK HARBOR.

for to go into detail on what is barely outlined in these few pages, would require a good-sized volume of the Engineer.

HISTORICAL AND STATISTICAL.

It was shortly after Mr. Edison had shown the world that an incandescent lamp could be made to last more than a few hours and had proved that the current could be distributed, practically and economically, underground, that a number of public-spirited and enterprising citizens of Brooklyn harbored the idea of conferring upon their own city the benefits of the new discoveries and inventions. But though the idea in itself was applauded and there was no lack of moral encouragement for the undertaking, capital was shy and preferred to wait in order to see what "the other fellow" was doing.

It had been easy enough, previously, to find men willing to invest money in electric lighting stations operating with overhead conductors and furnishing arc lights almost exclusively; but the laying down of a system designed from the start to be entirely below the street surface and entailing corresponding cost and designed primarily for incandescent lighting—the electric motor had barely begun to loom up—required, in a scattered territory like Brooklyn, courage of no small nature. Under the leadership of such men as Mr. Eugene Crowell, Mr. Ethan Allen Doty, Mr. George Foster Peabody, and those directly associated with them, the necessary capital was subscribed and in 1889 was begun the erection of the "First District" Edison station in Brooklyn.

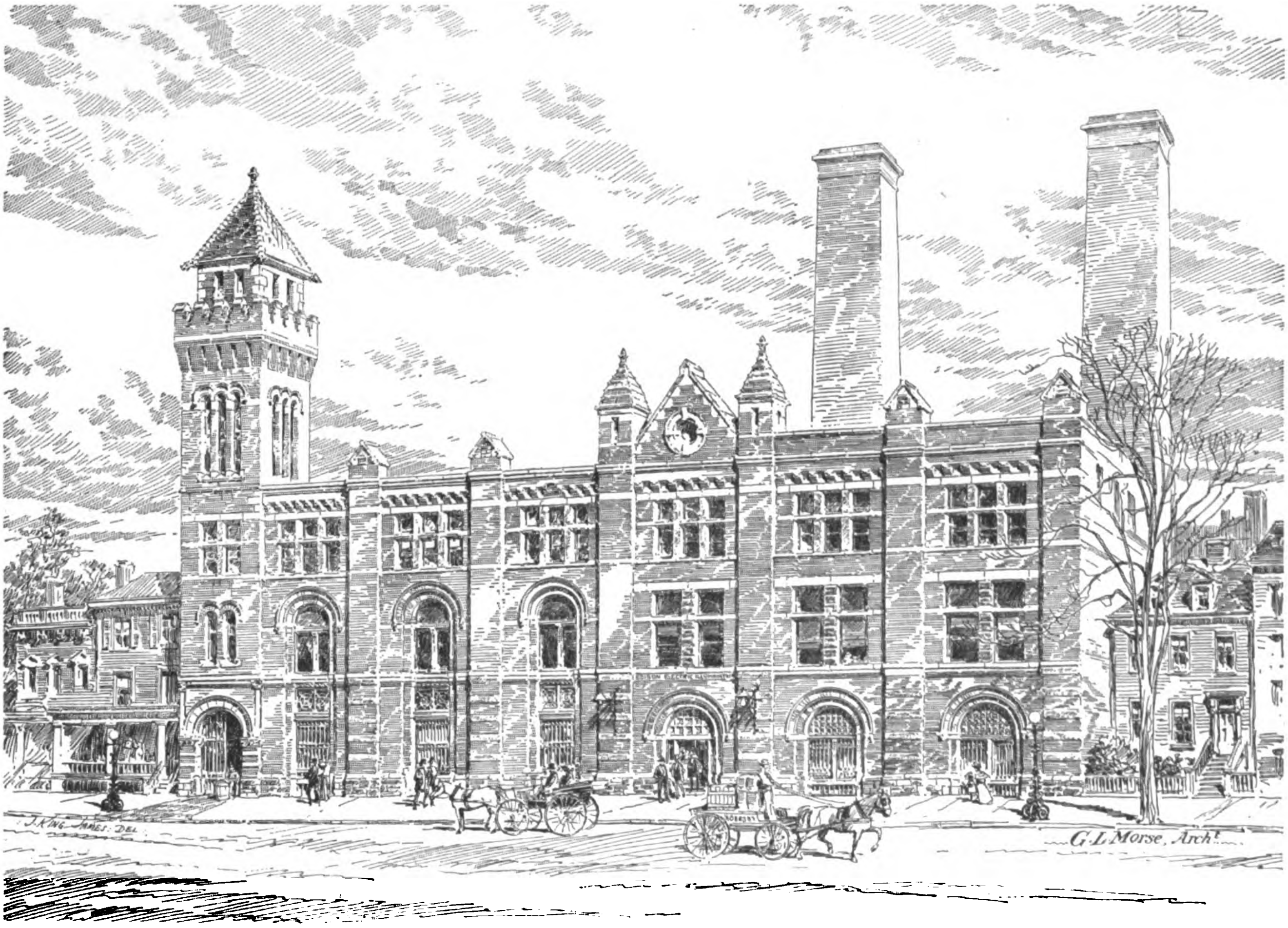
This station, situated on Pearl street, not far from the City Hall, was erected under the supervision of the company's first general superintendent, Mr. C. J. Field, and started with 6,600 lamps connected. The first year showed little profit,—none, indeed, was expected—but at the end of that period the equivalent number of lamps connected had risen from 6,600 to 25,170 16 c. p. lamps, distributed as follows: 17,356 incandescent lamps, 590 arc lights, 156½ h. p. in motors.

Encouraged by the rapid increase of business the stockholders authorized an increase of $900,000 in stock and $500,000 in bonds, paid for at par, and with the money thus realized the First District station was enlarged, and in addition a new station, the Second District, was established.

During this first year of operation the Brooklyn Edison Co. inaugurated a practice which has now become universal, and that is, the operation of arc lamps from low tension circuits. The success of this system was instantaneous and Brooklyn has from the very start kept ahead of its sister cities in the number of arc lamps operated in this manner.

It was shortly after the First District station went into operation that Mr. W. S. Barstow was appointed general superintendent.

The second year's operation was the turning point in the company's affairs. The number of equivalent lamps connected rose to 41,379, additions of an extensive character were made in station equipment and, what was most important, the payment of dividends was begun, at the rate of 4 per cent. per annum. Since then dividends have been paid continuously, rising during the last four years to the rate of 6 per cent. per annum.



FIRST DISTRICT STATION, EDISON ELECTRIC ILLUMINATING CO., BROOKLYN.

It would lead us too far to follow in detail the work of the company year by year. Suffice it to say that it has been one continuous record of improvement and progress which can be shown in no better way than by a glance at the accompanying table exhibiting the number of lamps, arc and incandescent, and of motors, connected, from 1890 to the present time.

	Incand. 16 c. p. equiv.	Arcs. low ten.	Motors. H.P.	Arcs. high ten.
Jan. 1, 1890	6,000	....	....	...
Jan. 1, 1892	26,753	908	430	...
Jan. 1, 1894	55,581	2,708	1,424	...
Jan. 1, 1896	84,818	3,284	2,623	1,897
Jan. 1, 1898	103,591	4,032	3,702	1,939

The last figures above represent the combined present output of the six Edison stations and substations as well as that of the Citizens' Electric Illuminating Co., which was acquired by

purchase in 1896. That figure, however, does not represent the full capabilities of the company by any means, as these have been immensely increased by the erection of the great new Union Station at Bay Ridge, of which more anon.

Before entering into a description of the company's latest work we propose to devote some space to a description of the Brooklyn Edison Co.'s older stations, so that our readers may gain an adequate survey of the situation in which the company found itself about a year ago, and which led to the adoption of its new 3-phase system and the erection of the great Union Station.

THE FIRST DISTRICT STATION.

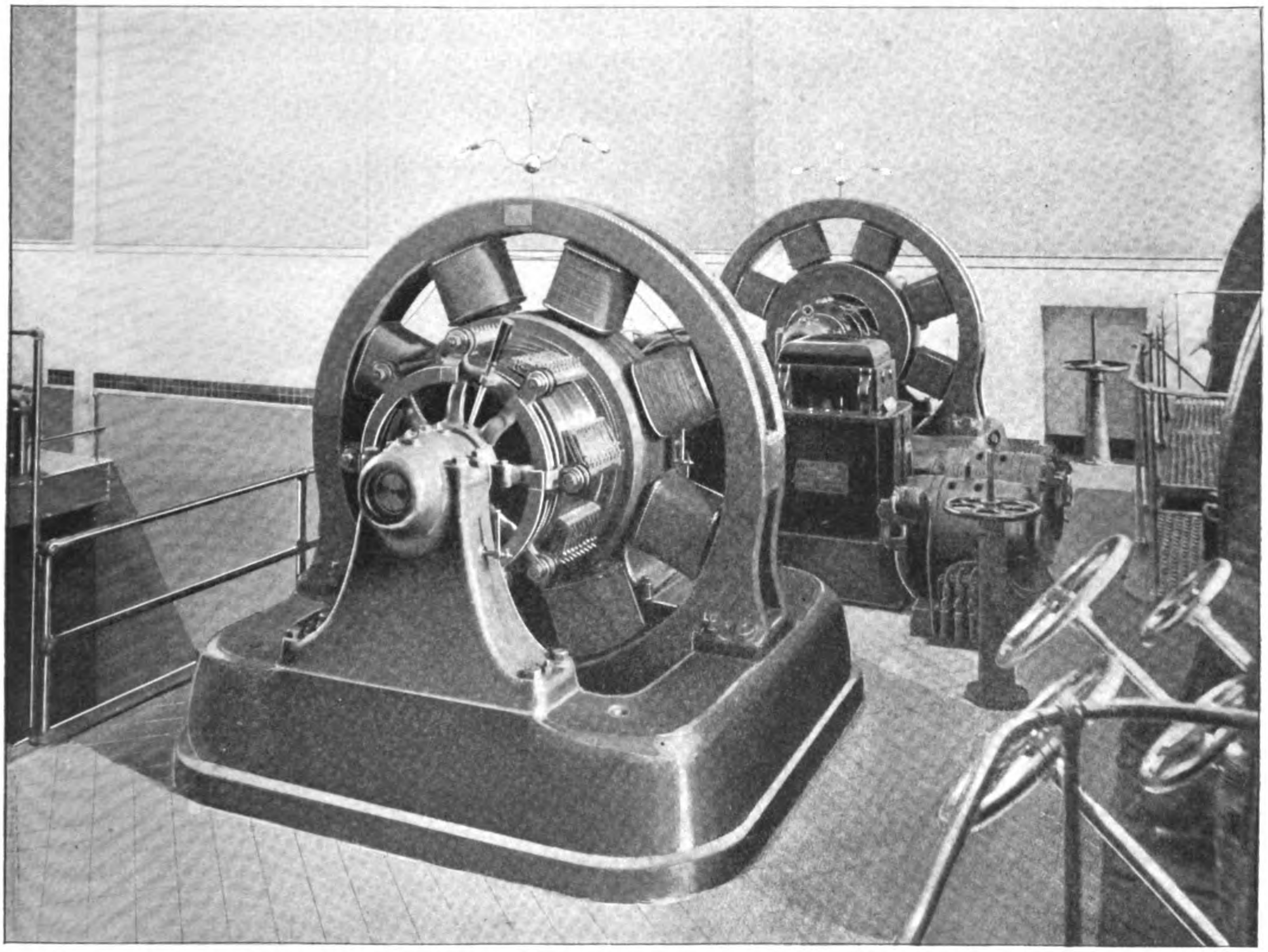
This station, known as the Pearl street station, was originally designed and erected in 1889 for an ultimate capacity of 3,000 h. p. In 1893 an addition, doubling the size of the building, was erected, and at the same time provision was made for remodeling the entire plant to accommodate vertical compound condensing engines, directly connected to multipolar generators.

The building as now finished is 150 feet front by 100 feet deep. The first floor is divided longitudinally into two rooms, one 70x100 feet, containing the engine and generator plant, switchboard gallery, etc.; the other, 71x100 feet, containing the boiler plant, above mentioned. The engine room has a height of 30 feet, while this corresponding height in the boiler room is occupied by boilers and coal storage bins.

A separate entrance to the building leads to the floor over the coal storage and engine room, where are located the offices of the company. These offices provide comfortable quarters for the president, secretary and treasurer, general superintendent, assistant secretary, auditor, bookkeeping department, meter department, purchasing agent, building department, canvassing department, testing department, machinists, street department, emergency and inspection department, steam department and electrical department.

This station, as remodeled in 1893, contains two units, each of 750 h. p., vertical cross-compound condensing Lake Erie Engineering Works engines, directly connected to two 200 k. w. Edison multipolar generators. Also two 1,200 h. p. vertical, three-cylinder, compound condensing engines, built by William Tod & Co., of Youngstown, Ohio, each being directly connected to two 400 k. w. Edison multipolar generators. All of these engines were designed by Mr. E. F. Williams, of New York.

In addition to these units there remained, as part of the old equipment, two 250 h. p. cross-compound Ball engines, built by the Ball Engine Co., Erie, Pa., originally installed in 1889, belted each to two 100 k. w. Edison bipolar generators.



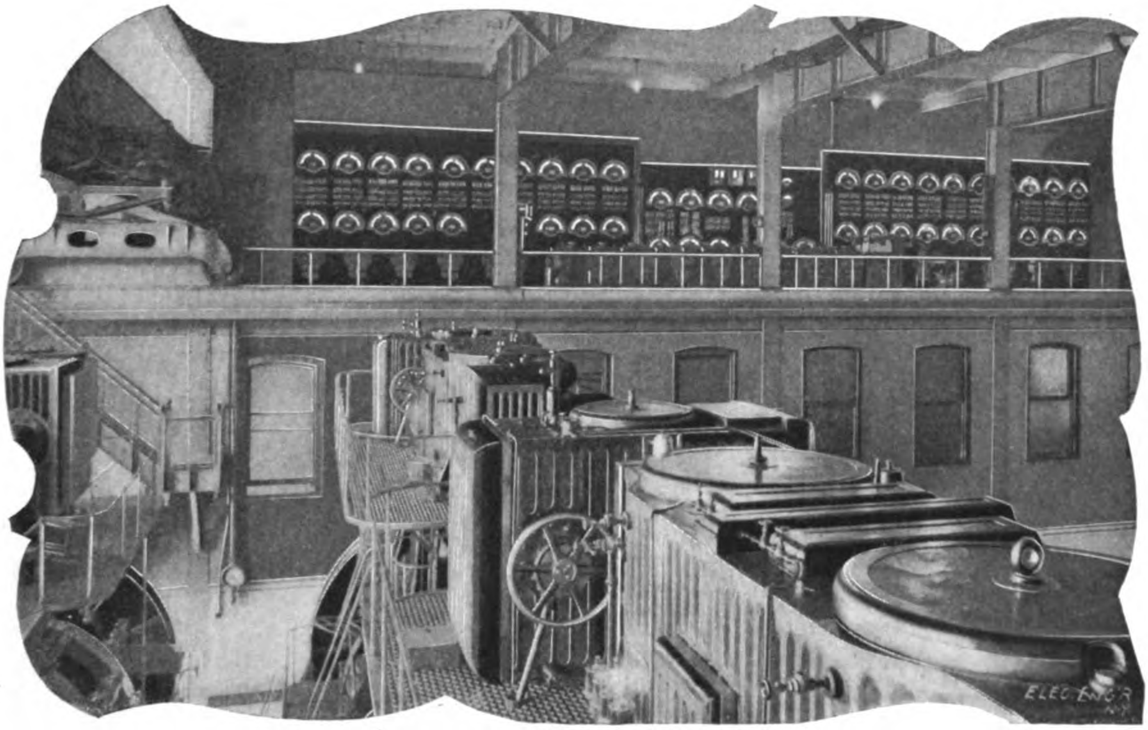
GENERAL ELECTRIC 400 K. W. ROTARY AND STATIC TRANSFORMER UNIT, FIRST DISTRICT STATION.

The steam for these engines is delivered from eight 240 h. p. Babcock & Wilcox boilers, furnished by the Babcock & Wilcox Company, one 600 h. p. Morrin vertical boiler and one 600 h. p. Columbia vertical boiler.

The condensing water for the plant is obtained from a Worthington self-cooling condensing equipment. This plant is interesting in that it is the largest self-cooling condenser plant in operation in the United States. The towers, as will be seen, on page 5, are placed upon the roof of the station at an elevation above the engine room of about 80 feet. They are two in number, having a total capacity of 5,000 horse power. The condensing apparatus, as shown on page 4, operates upon a new system that is especially adapted to large stations where there are a number of engines exhausting into a main exhaust trunk. Its principal feature is that the water from the condensation of the steam is pumped out of the condenser automatically by a water pump, while the air that leaks into

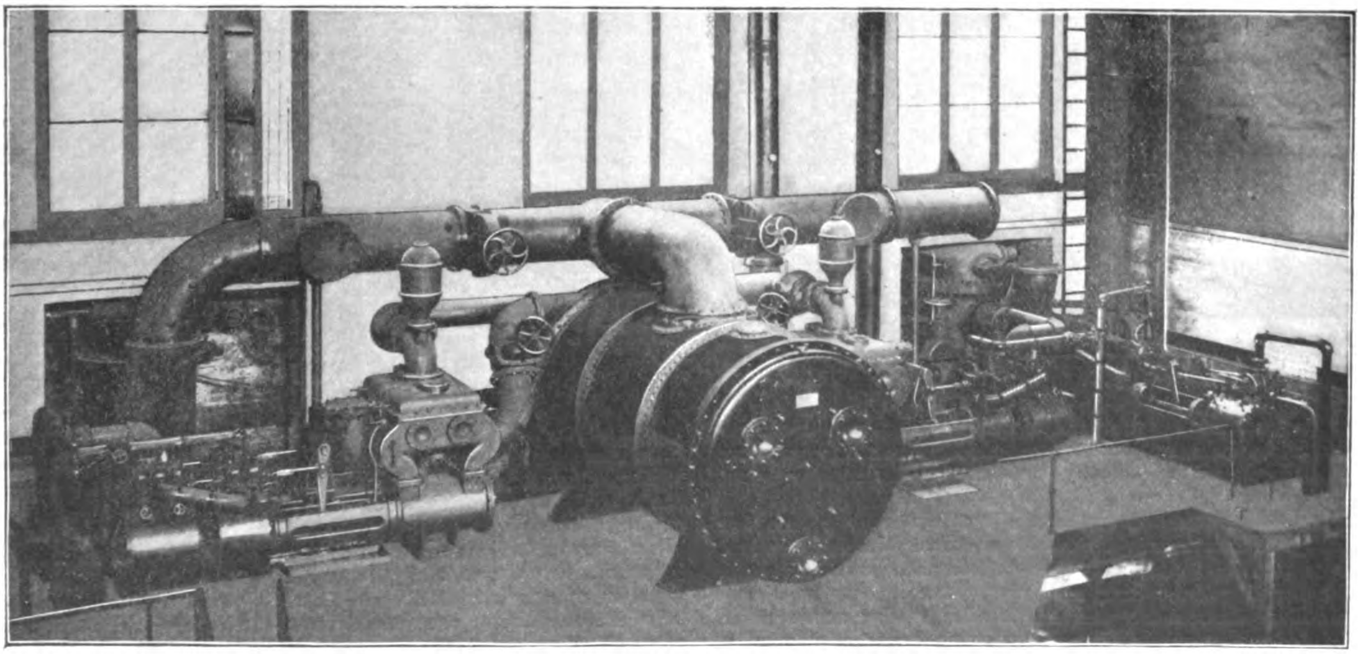
the system is pumped from the closed hot well by means of an air pump specially designed for pumping air alone. The highest vacuum is in this way obtained, and the speed of the latter pump is commensurate to the amount of air leakage, while the hot water pump simply removes the water that is condensed from the exhaust steam.

were on the same level as the condensing apparatus. The eight 6-foot air circulating fans of the cooling towers are driven by means of two electric motors so arranged as to be capable of being run in series or in multiple, and in connection with one or with both towers, as the condition of service may require.



HIGH AND LOW TENSION SWITCHBOARD IN FIRST DISTRICT STATION.

The surface condenser, which occupies a central position in this plant, has 8,000 square feet of cooling surface, the steam being exhausted around the tubes, and the cold water from the towers at an elevation of 80 feet is circulated by means of the circulating pumps through the tubes and back again to the top of the tower. In this way the power of the descending column is used to assist the ascending column, so that the real work done by the circulating pump is only the height of the towers, and the economical result is the same as if the towers



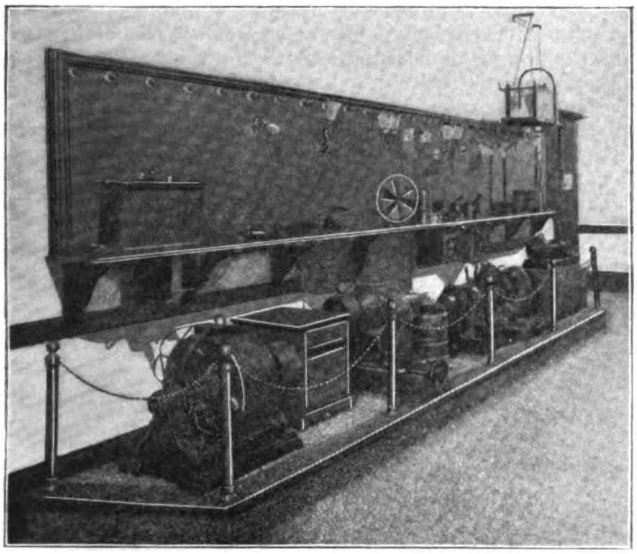
WORTHINGTON CONDENSER AND PUMPS, FIRST DISTRICT STATION.

The auxiliaries for this station are operated by steam, and the oil and air system is similar to that installed in the Union Station described later.

With the intention in the near future of shutting down this plant sixteen hours a day, there is installed in the engine room a rotary transformer unit, shown on page 3, consisting of three 140 k. w. General Electric static transformers and two 200 k. w. rotary transformers, with induction regulators, etc., all built by the General Electric Co.

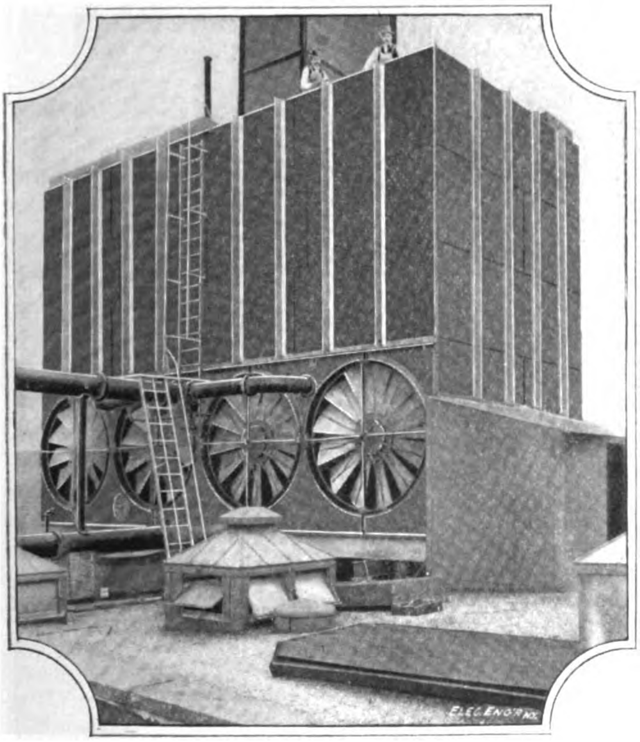
The high tension switchboard consists of a large panel of blue Vermont marble, containing 6,000 volt quick-break switches, mounted on corrugated rubber stands, 6,000-volt wattmeters, fuses, etc.

The low tension switchboard, which is the main switch-



EXHIBITION ROOM IN FIRST DISTRICT STATION.

board of the plant, is of black enameled Vermont slate, 54 feet long and 10 feet high, and as shown on page 4, occupies the whole length of the gallery. The generator panels and rotary panels are placed in the center, and the feeder panels on each side. On the machine panels are switches and instruments for six three-wire units, two boosters, tie lines, rotary transformers, etc. The duplex ammeter and voltmeter instruments are



WORTHINGTON WATER COOLING TOWER, FIRST DIST. STA.

of the Weston type, and Weston-Van Vleck edgewise voltmeters are used throughout. All feeder ammeters are arranged on the duplex system, the meters for the positive and negative side of the system being in the same case. The capacity of the switchboard is 5,000 k. w. at 125 volts.

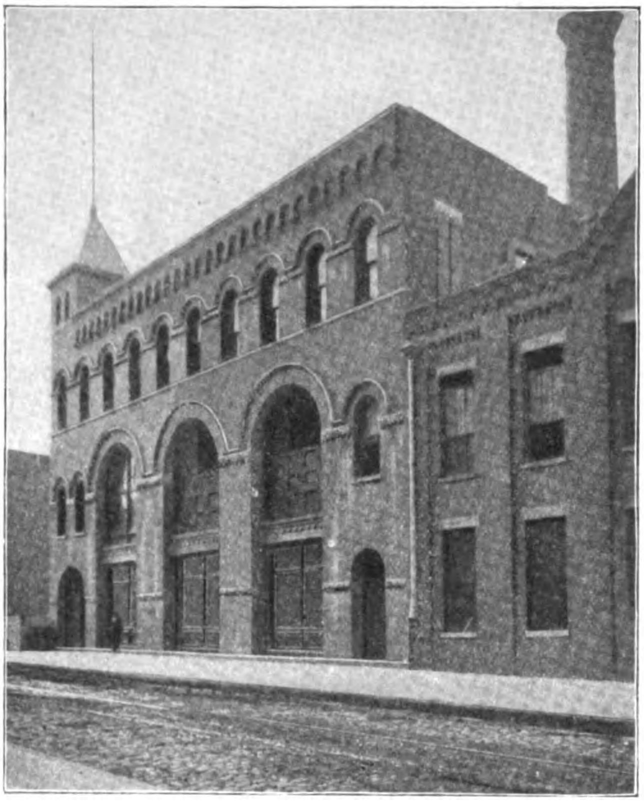
A 15-ton electric crane, built by the Morgan Engineering Company, spans the engine room, and enables any part of the equipment to be quickly and economically handled.

A large booster, built by the C & C Electric Co., in connection with the low tension tie lines enables this station to help out neighboring districts with low tension current in case of necessity. This station is now supplied by duplicate high tension, three-phase, alternating underground feeders from sub-station "A," as a distributing center, as described below.

SUB-STATION "A."

This station, formerly occupied by the steam plant of the Citizens' Electric Illuminating Co., situated at the corner of DeKalb avenue and Navy streets, forms the high tension distributing center for the main supply to the former steam plants of the Edison and Citizens' companies in the city of Brooklyn proper.

The original steam station at this point was made up of two buildings, one the original Thomson-Houston plant of the



SUB-STATION "A," BROOKLYN EDISON CO.

Citizens' Company and the other a fireproof structure, built to take care of the increased business. In the remodeling of this plant into an electrical transformer sub-station, only the new building has been occupied, and not the whole of this was necessary for transformer apparatus.

The former steam equipment of this station consisted of three 400 h. p. Wright-Corliss engines, two McIntosh-Seymour vertical triple expansion engines of 400 h. p., and one Hamilton-Corliss twin compound 1,200 h. p. engine. These engines were belted by means of countershafting to twenty 120-light, 1,200 c. p. Brush generators, furnishing current to the city street arc lighting system. This plant, with its complement of boilers, pumps, piping, heaters, etc., was entirely replaced, while in constant operation, by transformer units, necessary to convert the three-phase alternating current into current for series arc lighting.

The building, as it now stands, complete as a sub-station, consists of a fireproof structure, three stories in height, 75 feet front by 100 feet deep. The lower floor, located below the street level, and with an 18-foot head room, is divided into two rooms, one 45x90 feet, and the other 24x90 feet. In the former room are located the high tension and low tension transformer devices, with their switchboards, etc., while in the latter has been installed a large storage battery plant. Immediately above these rooms are the store rooms of the company, the incan-

descent lamp storeroom being about 20 feet square, with 12-foot ceiling, and the general storeroom 75x100 feet, with 12-foot ceiling. On the third floor are located the trimmers' quarters, arc lamp and meter repair rooms, and the inspection department.

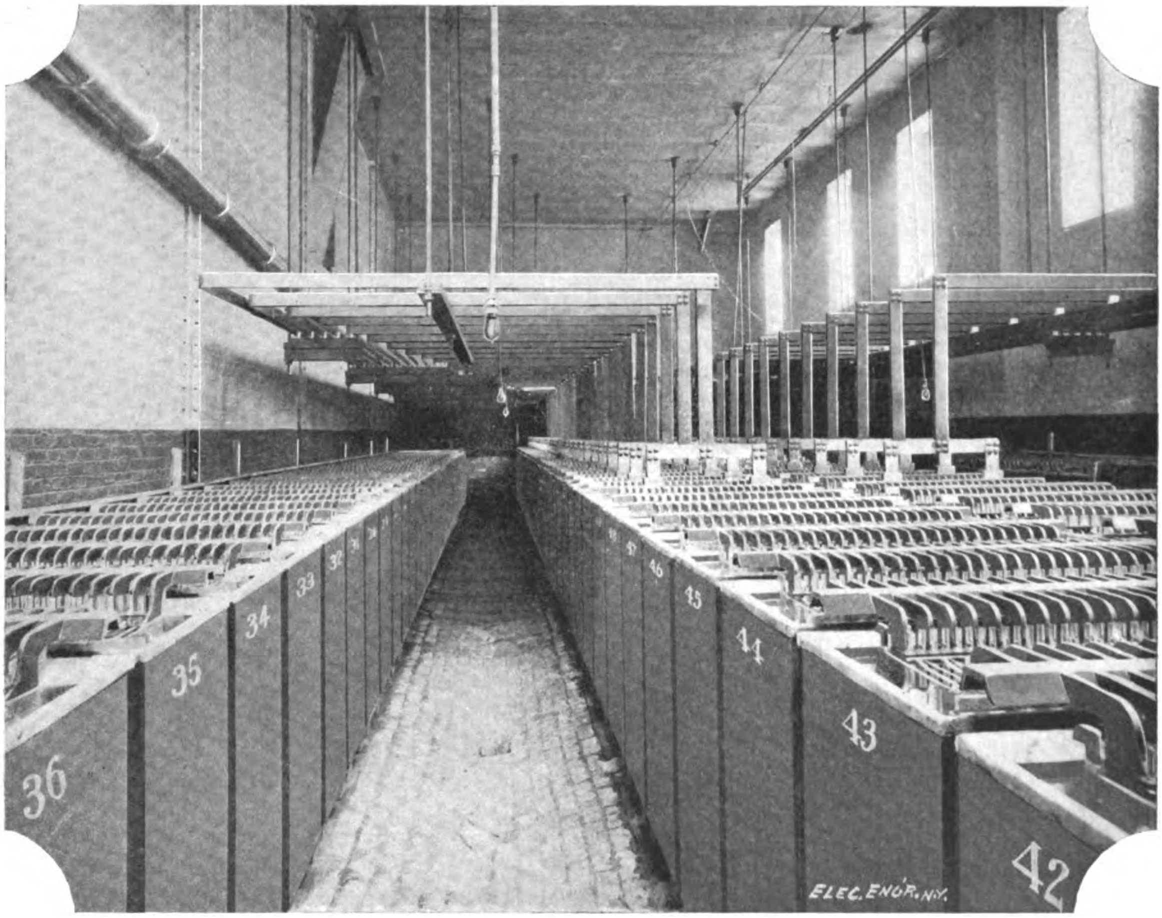
The transformer room on the first floor, as above mentioned, contains the static and rotary converters and the transforming units for taking care of the high tension series arc business of the city street lighting system.

Each of the arc units consists of a General Electric 100 k. w., three-phase, 6,000-volt, synchronous motor, directly connected on either end by flexible insulated coupling to two 120-light, 1,200 c. p. Brush generators (formerly used). This equipment is mounted on a heavy yellow pine base frame, suitably provided for keeping the three shafts in proper alignment. There are at present installed six of these units, of 240-light capacity each, the remainder of the arc lighting equipment being driven by low tension motors, supplied by a General Electric rotary transformer, used also for supplying current to the Edison low tension motors with additional high tension synchronous tion. It is the intention of the company to replace the low tension motors with additional high tension synchronous motor equipments at a later date.

The plant further contains a large 14,000 ampere hour, storage battery with a Churchward booster built by the Excelsior Electric Co., charged from the rotary transformers, above mentioned, and connected to the network of the Edison low tension underground system.

The high tension distributing switchboard, located in this station, and which receives the current from the Union Station, and distributes it, not only to this plant, but to the three Edison stations mentioned below, is located in a special fireproof vault, and is composed of blue Vermont marble, upon which are mounted quick-break switches of G. E. type, set on corrugated rubber projections and supported by barriers. These switches are not designed to be opened with load on, as it will never at any time be necessary to operate them under this condition.

The sub-station switchboard is about 40 feet long by 10 feet high, and is divided into three sections. The central portion of the board is of blue Vermont marble, equipped with quick-break switches, mounted on corrugated rubber stands with barriers, and high tension wattmeters. This portion of the switchboard is designed for the purpose of receiving from the distributing switchboard, located in the vault mentioned above, the three-phase current at 6,000 volts, necessary to take care of the transformer devices of this sub-station. On the right of this section are located the synchronous motor panels for supplying the three-phase current to the motor units, as above mentioned, and on the left a direct current rotary panel, suitable for supplying the three-phase current to static transformers for use with the rotaries. On the extreme right of the board are placed the high tension arc distributing panels, and on the extreme left, panels for receiving the direct current from the rotaries charging the battery and delivering current from the battery to the Edison system, as above mentioned.



STORAGE BATTERY IN SUB-STATION "A." BROOKLYN EDISON ILLUMINATING CO.

The rotary transformer equipment referred to consists of three 140 k. w. General Electric static transformers, receiving the three-phase current at 6,000 volts, and delivering it to the rotaries through induction regulators at 83 volts. The rotary transformers are two in number, each of 200 k. w. capacity, receiving the 83-volt alternating current and delivering 125 volts direct current on the three-wire system to the storage battery and the Edison underground system in the surrounding district.

The storage battery installed by the Electric Storage Battery Co., is located in the room directly in the rear of the sub-station switchboard, and adjoining the large transformer room. It consists of 156 cells, so arranged as to supply, by means of end cell regulating switches, current at two voltages at the same time on a three-wire system. This battery, illustrated on this page, is designed and connected to act as a safeguard to all other systems in case of accident to the main station,

and is capable of taking care of the entire business of the district, including the high tension series system, for a period of two hours, thus giving ample time for the starting of the two reserve stations mentioned below.

By means of the rotary and static transformers connected to the storage battery, 6,000 volts, three-phase current can be delivered from the battery to the synchronous motors running the arc machines at one pressure, while with the other pressure current can be supplied to the Edison low tension system of the surrounding district.

SECOND DISTRICT STATION.

This station, which is situated on Lexington avenue, between Grand and Classon avenues, conected by duplicate underground feeders with the high tension distributing center of substation "A," described above, is one of the original Edison stations, and up to within a short time was operated as a steam station. The building is 60x100 feet, one-story in height and with iron truss roof.

The equipment of this plant consisted, previous to the starting of the three-phase system, of two 250 h. p. Erie-Ball high speed, twin compound, condensing engines, belted each to two 100 k. w. Edison bi-polar, 125-volt generators. Also two 250 h. p. Erie-Ball high speed, twin compound, condensing engines, each belted to one 180 k. w. two-phase Stanley alternator, delivering 2,400 volts at 66 cycles. One of these Stanley alternators is shown on page 9. The above engines are supplied from three 300 h. p. Morrin "Climax" boilers, and the con-

densing is accomplished by a Worthington self-cooling jet condenser with a cooling tower.

There is also installed in the same building a 7,500-ampere hour storage battery plant, illustrated on this page, consisting of 160 cells, and provided with four 30-point end cell switches, so arranged as to provide for a discharge at two different voltages at the same time. This battery was installed by the Electric Storage Battery Co.

The direct current switchboard, of black enameled Vermont slate, is 23 feet long, and contains the switches and Weston round type instruments for the generators and feeders of the station. This board also contains the small switches for controlling the motors operating the end cell battery switches, and also the battery instruments. The capacity of this board, including the battery, is 1,200 k. w. at 125 volts.

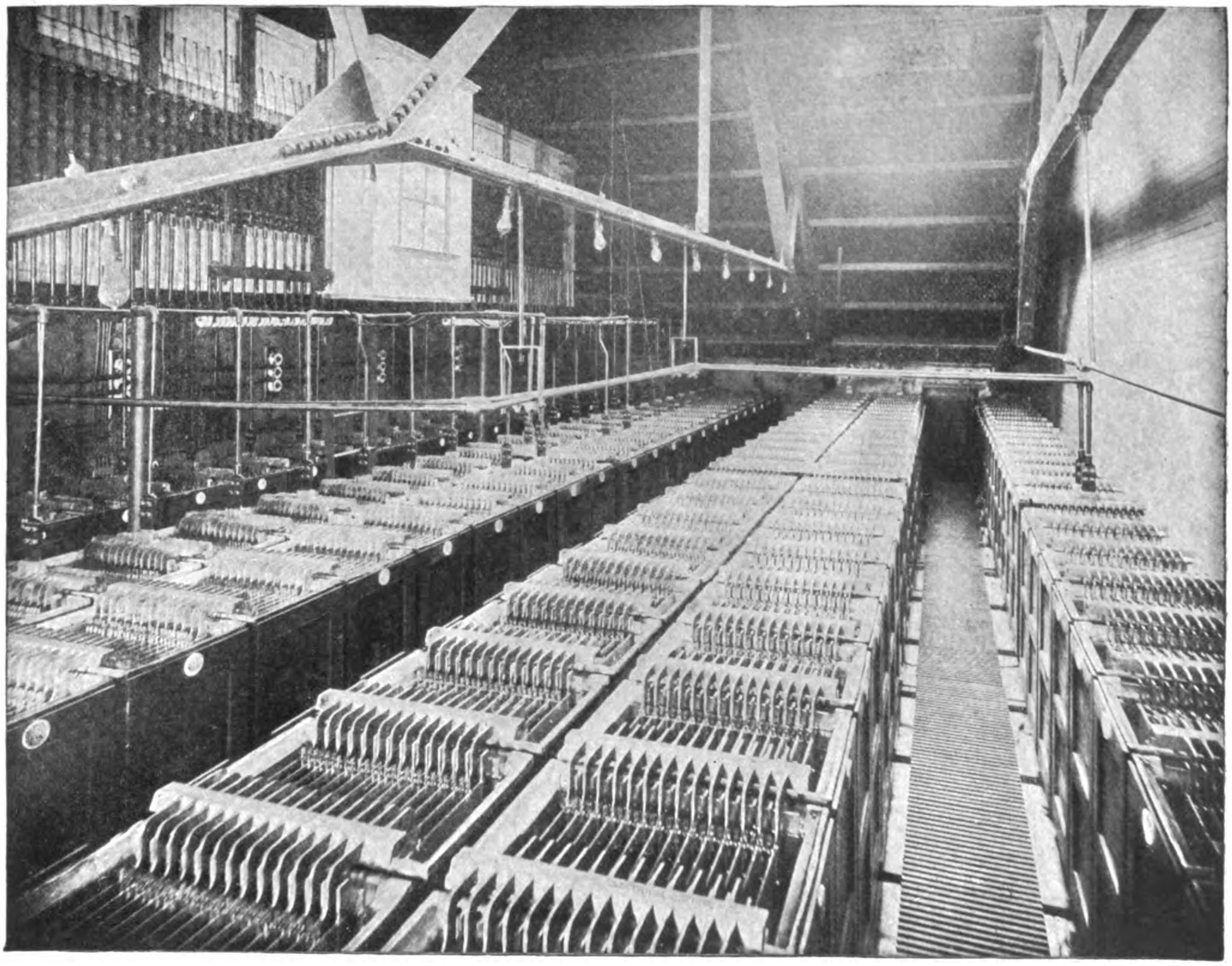
The two-phase alternating current switchboard is of blue Tennessee marble, 21 feet in length, and is equipped with synchronizing devices, five feeder panels, machine panels, etc. Each machine panel has two 2,400-volt, double pole, double throw, Stanley switches, located on the rear of the board, and worked from the front by rack and pinion. Each machine panel has two Whitney ammeters, two Weston voltmeters, two Weston wattmeters, field switch, rheostats, synchronizing lamps, etc. The two-phase feeders leaving the station are provided with Stillwell regulators.

This station, as above described, is now being entirely replaced by transformer apparatus, necessary to transform the three-phase current from the Union Station into low tension current for the Edison three-wire system of the surrounding district, and two-phase, 60-cycle, 2,400-volt current to maintain the alternating distributing system.

Frequency Changers.—The object accomplished by these devices, to be installed in this station, is the conversion of current of low frequency into current of high frequency. The alternating current, as generated in the main station, has a frequency of 25 cycles per second, which is rather too low for incandescent lighting as used in Brooklyn.

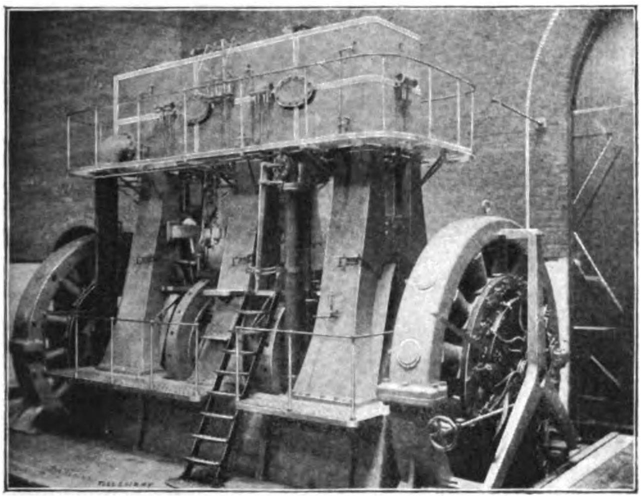
The frequency changer, shown on page 9, consists of a generator similar in general construction to the ordinary induction motor. This generator is directly coupled to a synchronous motor, by which it is driven. The low frequency alternating circuit is connected to the stationary part of this induction generator. The high frequency circuit, supplied by it, is connected to the revolving part through collector rings and brushes. When the primary or stationary part is connected to the circuit the tendency of the machine would be to revolve as an induction motor in a certain direction. This tendency is overcome by the synchronous motor which forces it to revolve in a direction opposite to that of its inclination. If the induction generator stood still when connected to the low frequency circuit it would act as a stationary transformer, and 25-cycle currents would be generated in its secondary. When, however, it is driven by the synchronous motor in a direction contrary to that of its inclination, the frequency of alternation of flux in the secondary is increased, and the frequency of currents there generated is consequently raised.

In the present case the frequency is raised from 25 cycles to 60 cycles. When the set is in operation, the power delivered to the high frequency secondary is derived from two sources, part being taken directly from the low frequency circuit and transformed in the induction generator, the remainder being delivered in mechanical form by the synchronous motor. The rated output of each of these sets is 200 k. w. The size of the motor and generator used in each is practically half that which would be required if a motor-generator set of the ordinary type be used.



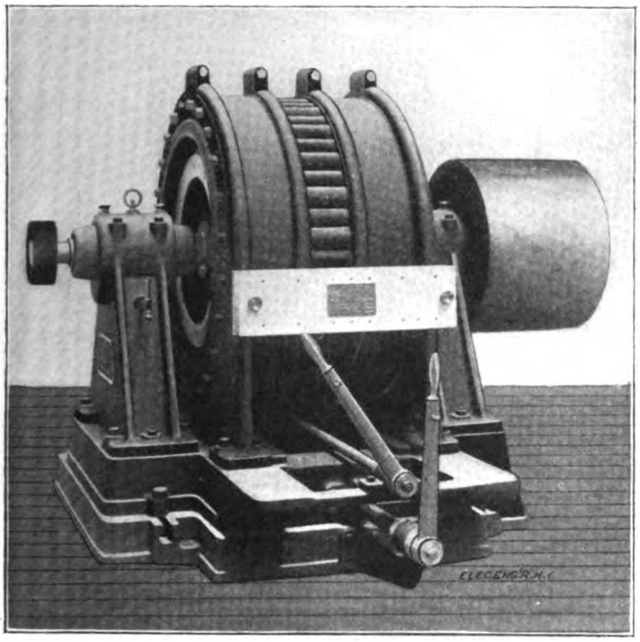
STORAGE BATTERY IN SECOND DISTRICT STATION, BROOKLYN EDISON ILLUMINATING CO.

The losses of the transformation are proportionately less than they would be in an equivalent motor-generator set. The alternating power is delivered to the induction generator from transformers, and the alternating power delivered to the synchronous motors directly from the high tension lines, this motor being similar to those used elsewhere for operating pairs of arc dynamos.



TRIPLE EXPANSION DIRECT CONNECTED UNIT, 3D DIST. STA.
(William Tod & Co., Engine and General Electric Generators.)

The direct current transforming apparatus consists of three 140 k. w. General Electric static transformers, which take the current from the high tension distributing center (sub-station "A") over two miles of underground conductors, at 6,000 volts, delivering it to the rotaries, through the induction regulators, at 83 volts. These rotaries, two in number, and each of 200 k. w. capacity, take the current at 83 volts alternating and deliver it to the three-wire system at 125 volts, three-wire, direct current.



STANLEY 180 K. W. TWO-PHASE GENERATOR IN 2ND DISTRICT STATION.

There will shortly be in operation at this station the General Electric "phase voltage alternation" transformer to replace the two-phase machines. This transformer takes the three-phase, 6,000-volt, 25-cycle, alternating current of the main station and transforms it into two-phase, 2,400-volt, 60-cycle, alternating current for the two-phase distributing system. When this apparatus is in place (which will be about March 1) the entire steam plant in this station will be dispensed with, the station operating continuously as a transformer sub-station.

THIRD DISTRICT STATION.

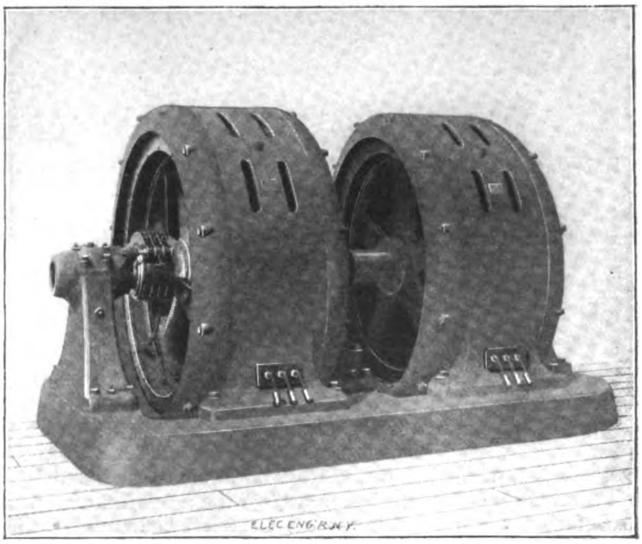
The Third District station, situated on Gwinnett streeet, within a few rods of Marcy avenue, is connected to the high tension distributing center (sub-station "A") by underground feeders, two miles in length. This station, erected by the company in 1892, covers an area of 70x120 feet, and 40 feet in height, this one story being covered by an iron truss roof. It is divided transversely into two rooms, one 45x70 feet, and the other 55x70 feet. The former contains three vertical Morrin boilers, two of 250 h. p. each, and one of 600 h. p.

The engine room contains two 750 h. p. vertical, triple expansion, condensing, Williams engines, one built by the Lake Erie Engineering Works and the other by William Tod & Co. Each engine is directly connected to two 200 k. w. Edison multipolar generators, 125 volts. The water for condensing is furnished by driven wells, a Conover vertical air pump condenser and a Dean jet condenser being used. One of the 750 h. p. engines is directly connected to its own independent air pump in conjunction with a jet condenser.

The switchboard is 20 feet in length by 10 feet in height, of black enameled Vermont slate, and contains the low tension switches, Weston ammeters, voltmeters, etc.

A G. E. booster supplies current to a tie line connecting this station with the Second District station, which in turn, as before described, is connected to the First District station, thus enabling the three stations to exchange low tension current in case of necessity.

For the purpose of shutting down this station 16 hours a day, there is installed a transformer unit, similar to that installed in the First District, consisting of three 140 k. w. General Electric static transformers, two 200 k. w. rotary transformers, with induction regulators, etc.

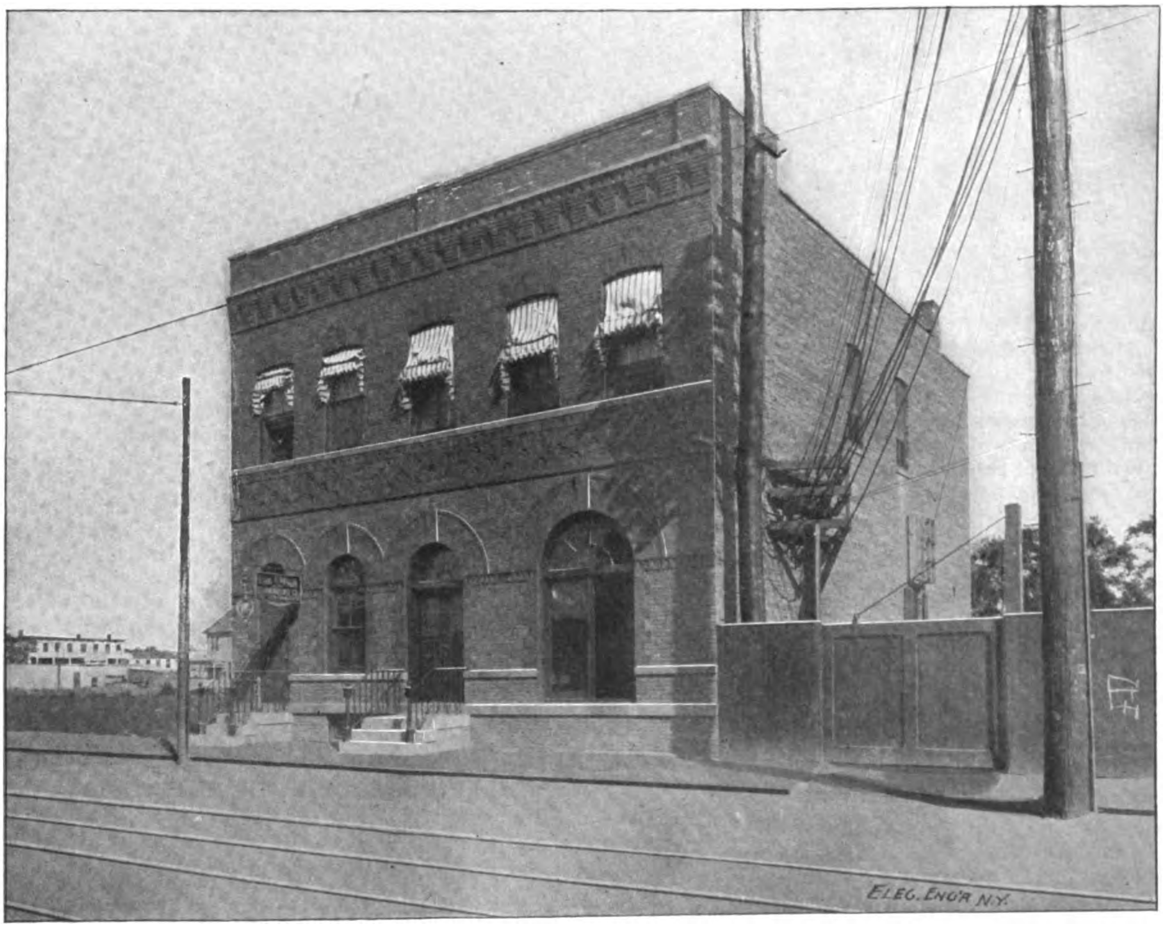


FREQUENCY CHANGER, SUB-STATION E.

SUB-STATIONS "B," "C" AND "D."

Sub-station "B" is located at Bergen Beach, nine miles from the Union Station. It is connected with the Second District station, a distance of eight miles, by overhead feeders. The building consists of a small frame structure 18 feet square, containing the phase and static transformers for reducing the two-phase, 2,400-volt, 66-cycle, current into low tension alternating current for distribution. It is the purpose in the near future to build a more substantial station, connecting it with the main Union Station, and to install the necessary phase and frequency changers. This station is shown on page 9.

Sub-station "C" is similar in character to sub-station "B," and is not yet of a permanent character, as both these sub-stations are in operation but to a very small part of their capacity except during the summer months.



EXTERIOR OF SUB-STATION "E," AT CONEY ISLAND, BROOKLYN EDISON ILLUMINATING CO.

Sub-station "D," designed for the East New York section of the city, has not yet been constructed, the district being at present supplied with two-phase alternating current from the Second District station. In this sub-station will be placed step-up transformers, raising the pressure from 6,000 to 12,000 volts for transmission to the Long Island system.

SUB-STATION "E."

The district occupied by this station is one of the many suburban watering places surrounding Brooklyn proper. Coney Island, known throughout the world for its entertainment facilities ,and for its "Bowery," is in full blast from May 1 to October 1, during which time no expense is spared by its inhabitants for lighting, etc., to attract the attention of visitors. The station is located close to the electrical center of distribution, and is modern in all respects.

The building, a view of which is given on this page, is of brick, quite ornamental in character, having a frontage of 40 feet and a depth of 50 feet. The upper, or second story, is divided into two apartments, occupied by the employés (and families) who take care of the station. These living apartments are independent of and entirely cut off from the remainder of the building, having a separate vestibuled entrance and also a private cellar for storage.

The first floor is divided into office and transformer room, the latter entering through the former, which has entrance direct to the street. The plans and sectional views on page 12, illustrate the arrangement of this novel type of sub-station.

The transformer room covers a space of 1,500 square feet, and provides for transformers of a total capacity of 1,000 k. w. All conductors enter and leave the building overhead. The incoming conductors, six miles in length, from the Union Station, supply three-phase current at 6,000 volts, 25 cycles, and the outgoing supply (1) low tension direct current, 115 volts, three-wire system; (2) high tension current for series arc lighting; and (3) two-phase, 2,400-volt, 60-cycle, for local suburban distribution. No lightning arresters are used on the overhead circuits other than two barbed wires run on the top of the cross-arm of the poles and grounded at frequent intervals.

The transformer equipment of this station, all of the General Electric type, consists of six 140 k. w. static transformers, which supply 83 volts alternating three-phase current to six 100 k. w. rotary transformers for the low tension Edison three-wire system, and a 200 k. w. phase-voltage alternation transformer to supply the 2,400-volt, two-phase, 60-cycle, distributing system for use beyond a radius of one mile. In conjunction with the rotary transformers are the standard induction regulators, etc. There are also installed synchronous motor arc generator units, such as described in connection with sub-station "A," for the conversion of the three-phase, 6,000-volt, 25-cycle, alternating current into the direct current for series lighting. Such a synchronous motor unit driving a Brush 120-arc light machine (by belt temporarily) is shown in the foreground in the engraving on page 11.

The switchboard, 30 feet in length, is divided into three sections. The center portion of the board, of blue Vermont marble, is equipped with quick-break switches, mounted on corrugated rubber stands, so arranged as to distribute the 6,000-volt,

three-phase current, either to the static transformers or to the synchronous motors. On the left is placed the low tension switchboard, of black enameled Vermont slate, containing the low tension switches, feeder switches, Weston voltmeters, ammeters, etc. On the right of the switchboard, on Vermont marble, is placed the series arc distributing switchboard, and also the two-phase distributing switchboard. Each portion of the switchboard is furnished with recording wattmeters, so that the use of the current for the different purposes can be readily ascertained.

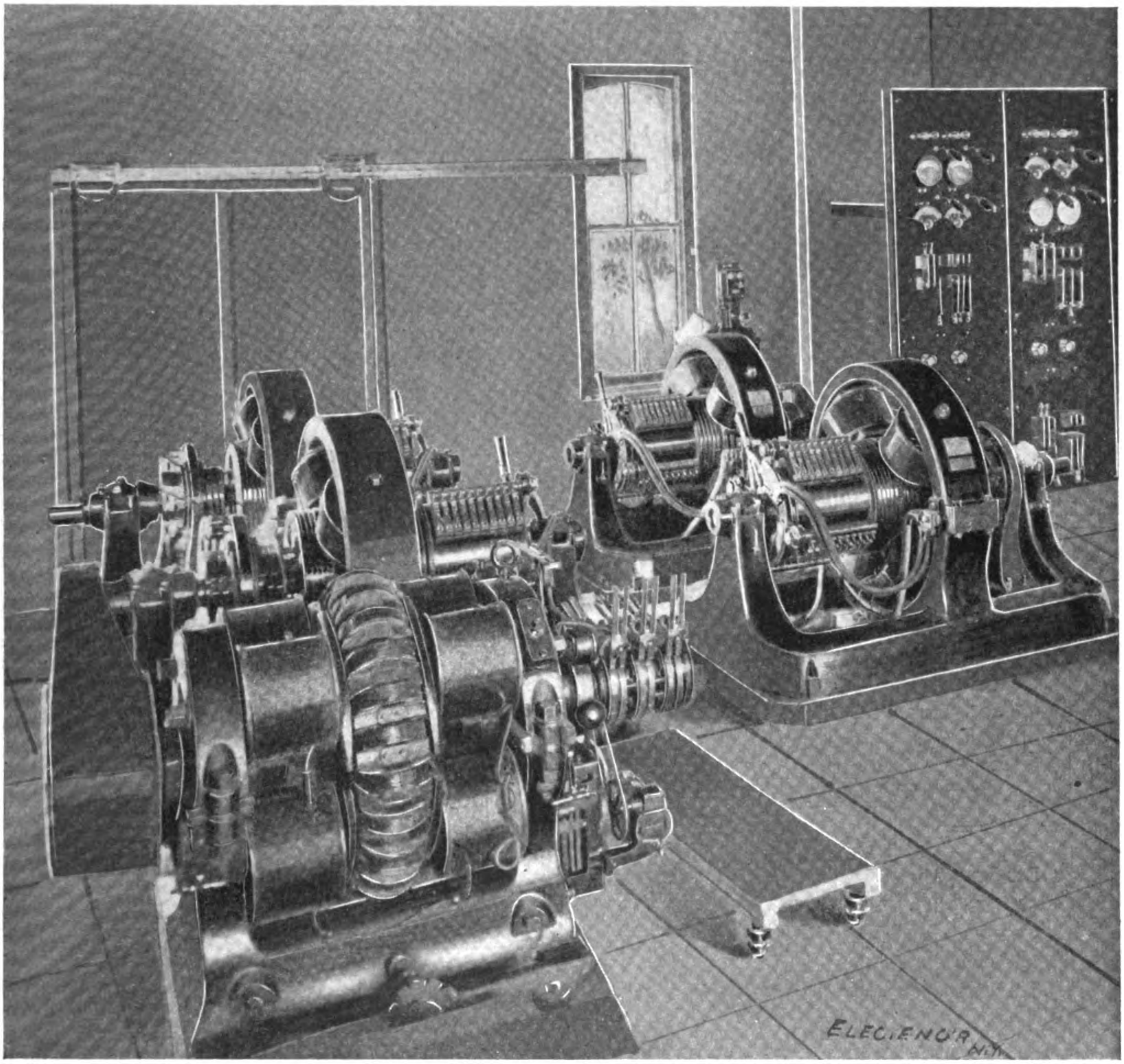
SUB-STATION "F."

This sub-station, situated on Carroll street, is unique in general appearance and design. The district in the center of which it is located is occupied by handsome, private residences, apartment houses and churches, and is what might be termed a strictly residential territory.

In the heart of such a district the company purchased a small frame house, which had been occupied for the past twenty years. The external appearance of the building, shown on page 13, was left undisturbed. The interior was remodeled so that the parlor and upper rooms were made into one large room, in which are installed four 100 k. w. rotary transformers. The extension to the house, formerly the kitchen (the stove is still in place, as seen in the engraving on page 13, became the switchboard room, while a small brick fireproof building in the rear contains the 140 k. w. static transformers and regulators, all of the General Electric type. All current enters the building underground at three-phase, 6,000 volts, and also leaves, underground on the direct current, 115 volts, three-wire system. So carefully have all details been arranged that no one passing along the street or entering the courtyard sees or hears anything which would lead him to suppose that the building was not occupied as a residence.

The station is attended to by one person on a watch, who has no trouble in taking care of the load of 2,000 amperes.

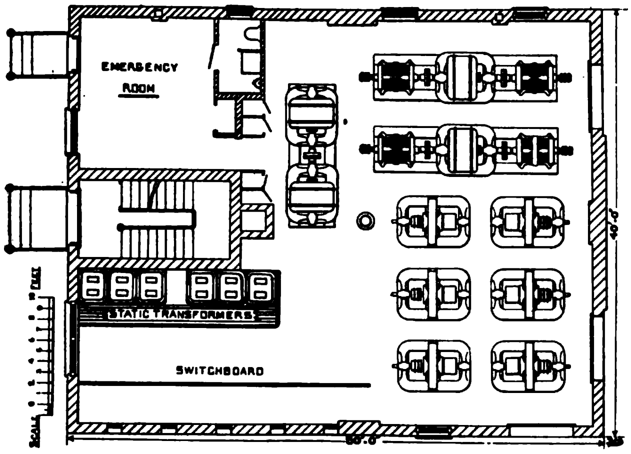
The high tension switchboard of this station, of blue Vermont marble, is located in a fireproof brick building in the rear of the house. The low tension switchboard is of black Vermont marble, and is located in the former kitchen of the house. It is equipped with low tension feeder switches, rotary transformer switches, ammeters, voltmeters, recording wattmeters, etc., so as to enable the current delivered by the station to be closely ascertained. The plan and sectional views on page 12 show the arrangement of this unique little plant.



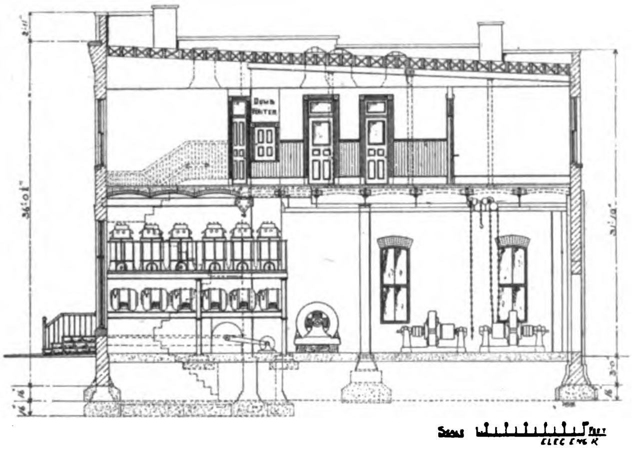
GENERAL ELECTRIC ROTARY TRANSFORMERS AND BRUSH ARC DYNAMOS, SUB-STATION "E," CONEY ISLAND.

RECAPITULATION OF GENERATING SYSTEM.

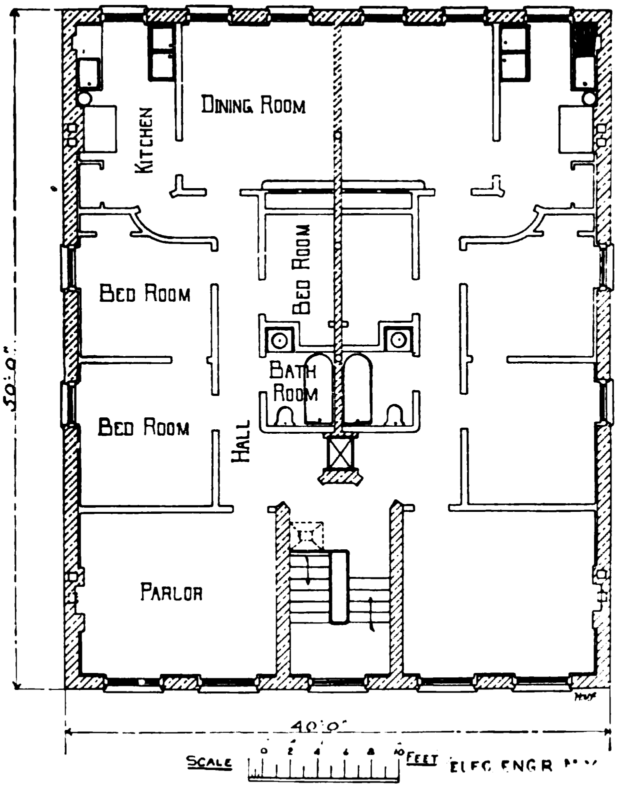
In order to give out readers some idea of the present state of the generating and sub-station system of the Brooklyn Edison Co., as embodied in the stations just described, we give



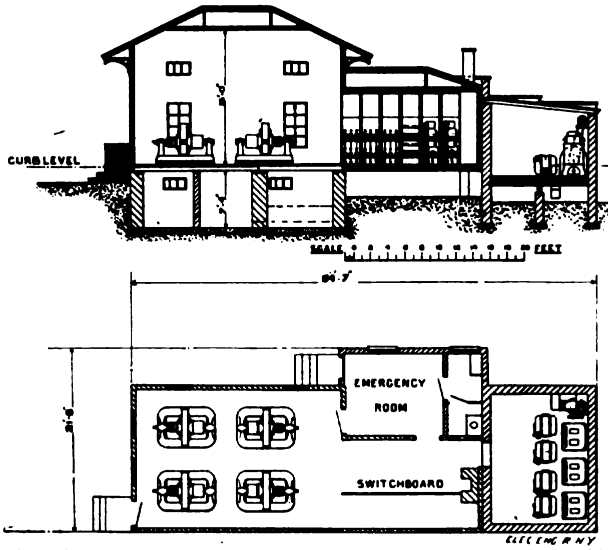
SUB-STATION "E," CONEY ISLAND.—PLAN OF FIRST FLOOR.



SUB-STATION "E," CONEY ISLAND.—SECTION.



PLAN OF LIVING APARTMENTS, SUB-STATION "E," CONEY ISLAND.



SUB-STATION "F," CARROLL ST.—PLAN AND SECTION.

below a classified digest of the various types of apparatus employed. This does not include the new Union Station.

TYPES OF APPARATUS EMPLOYED.

Class A.—Vertical engines directly connected to low tension direct current multipolar generators, three-wire system, with corresponding boiler equipment.

Class B.—Static and rotary converters and induction regulators to transform 6,000 volts, three-phase, 25 cycles, alternating into low tension direct current, three-wire system.

Class C.—Synchronous motor arc generator to transform 6,000 volts, three-phase, 25 cycles, alternating, into from 2,000 to 6,500-volt direct current for series arc circuits.

Class D.—Static transformers, synchronous and induction motor, to transform 6,000 volts, three-phase, 25 cycles, alternating, into 2,400 volts, two-phase, 60 cycles, alternating.

Class E.—Storage battery for low tension three-wire system.

Class F.—Static transformers, two-phase, 2,400 volts, 60 cycles, to 115 volts alternating.

The following table indicates the stations or sub-stations in which these various types of apparatus above enumerated are employed, and the amount of power in kilowatts represented by each type:

EDISON FIRST DISTRICT.

2,800 k. w. .... Class "A"
400 k. w. .... Class "B"

EDISON SECOND DISTRICT.

400 k. w. .... Class "B"
7,500 ampere-hour storage battery .... Class "E"
400 k. w. two-phase, 2,400 volts, 60 cycle generating equipment.

EDISON THIRD DISTRICT.

800 k. w. .... Class "A"
400 k. w. .... Class "B"

SUB-STATION "A."

600 k. w. .... Class "C"
400 k. w. low tension motors driving arc generators.
400 k. w. .... Class "B"
14,000 ampere-hour storage battery .... Class "E"

SUB-STATION "B."

200 k. w. .... Class "F"

SUB-STATION "C."

300 k. w. .... Class "F"

SUB-STATION "D."

(Not completed).

SUB-STATION "E."

600 k. w. .... Class "B"
100 k. w. .... " "C"
200 k. w. .... " "D"

SUB-STATION "F."

400 k. w. .... Class "B"

SUB-STATION "G."

200 k. w.	Class	"B"	
100 k. w.	"	"C"	Not yet com-
200 k. w.	"	"D"	pleted.

CONSIDERATIONS DETERMINING THE CONSTRUCTION OF THE UNION STATION.

With this necessarily brief review of the Brooklyn Edison Co.'s original plant and its gradual accretions we come to the consideration of its latest and highest development in station construction, the Union Station, at 66th street, Bay Ridge. But before entering into the details of this truly magnificent undertaking it will prove instructive, we believe, to trace the steps and conditions which finally led up to it.

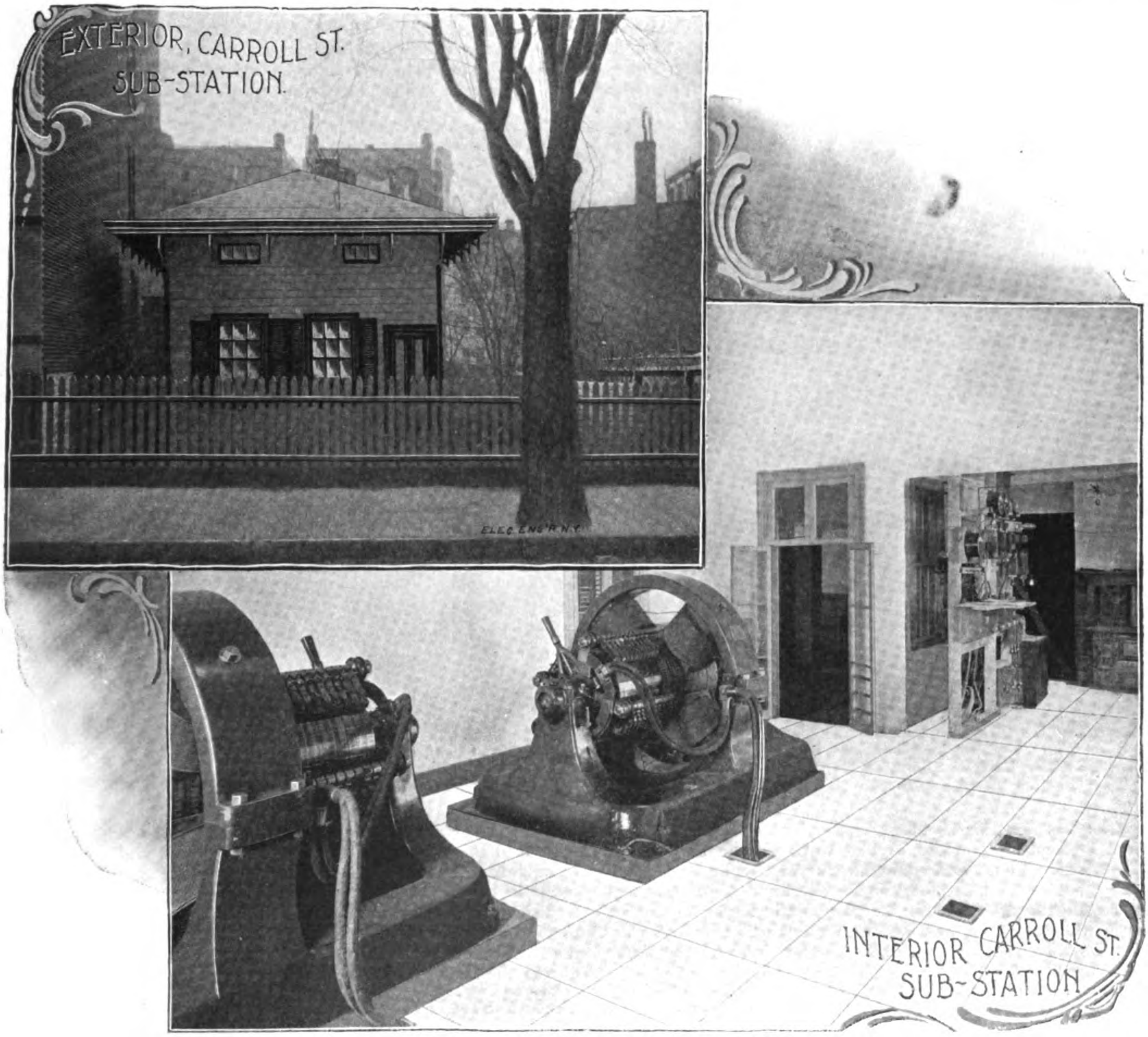
The purchase of the Citizens' Electric Illuminating Co., of Brooklyn, by the Edison Electric Illuminating Co., of Brooklyn, it may be recalled, was made during the early part of 1895, the Edison Company taking actual possession of the stations of the Citizens' Company on July 1 of that year. After making alterations and additions to the Citizens' stations, whereby increased business could be taken care of, attention was given to increasing the economy of the two companies by operating them in conjunction.

The Edison Company was at this time operating under an exclusive underground franchise, a three-wire, 115-volt system, and the Citizens' Company operating under an overhead franchise a high tension, series arc system from 120-light (1,200 c. p.) Brush machines and a 2,400-volt, two-phase, 60-cycle alternating system. At the same time questions were constantly arising as to the means of extension into new districts, so that the problem became quite complicated.

General Superintendent Barstow, of the Edison Company, appreciated the fact that the highest economy could be obtained only when all the systems of the two companies were operated from a common source, and accordingly began working on laying out a high tension transmission system. The plans were finally submitted to the officers of the company on September 1, 1896, and were in turn presented to the directors of the company on November 2.

The plan, as outlined in the report, consisted of the erection and operation of a high tension alternating station, located on the water front, in which the loads of the various stations and systems could be consolidated on one set of generators. From this plant, underground feeders carrying the alternating current at a pressure of 6,600 volts, were to extend to all the present stations of the two companies, the current being brought from the water front station to the center of the city and there distributed. The low tension, three-wire, generating apparatus in the various stations was to be replaced with static transformers, reducing the current from high to low voltage alternating, and by means of rotary transformers furnishing direct current.

The high tension series apparatus was to be replaced by high tension synchronous motors, either end of which direct con-



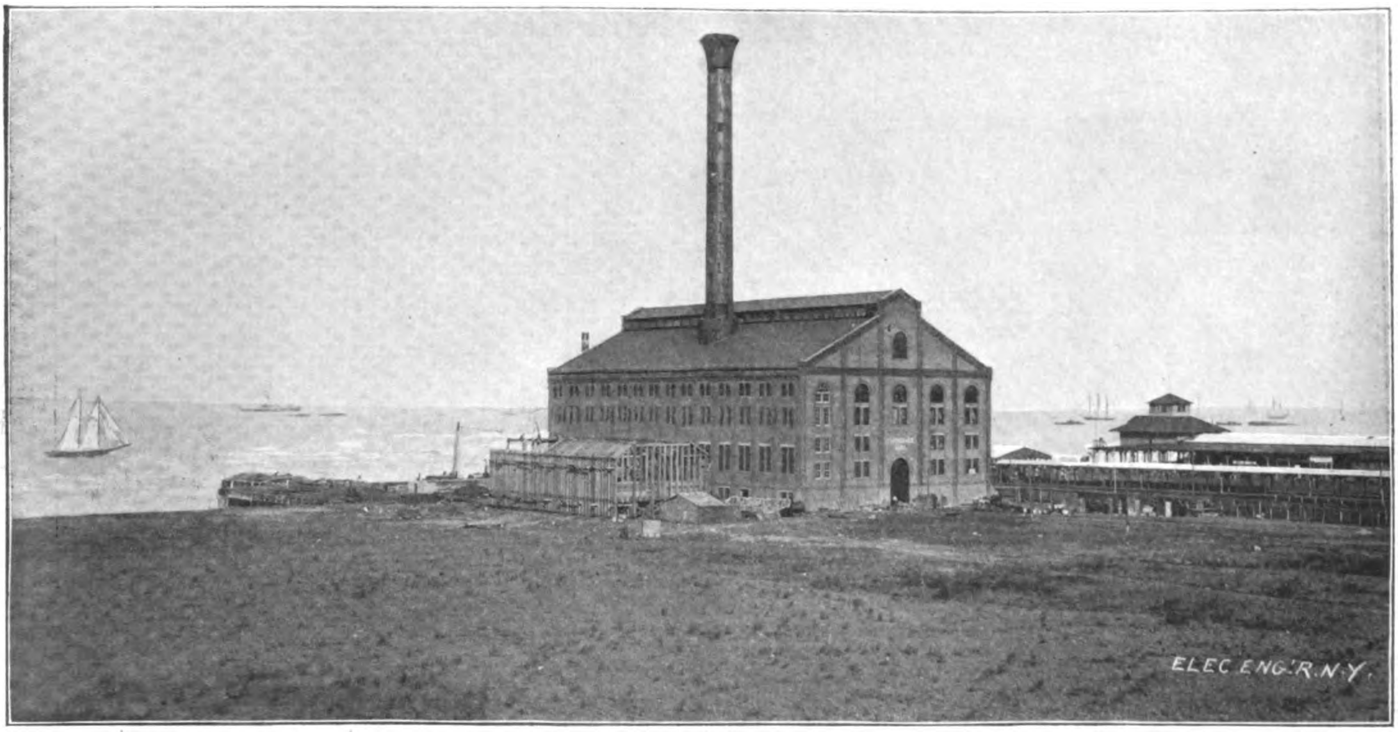
nected to a 120-light series arc generator. The two-phase alternating apparatus was to be replaced by phase alternation transforming apparatus, which at the same time would reduce the voltage.

The alternating current selected, after carefully going into the matter, was three-phase at 25 cycles and 6,600 volts. Current at this pressure was to be taken direct from the large generators and delivered to the static transformers in the substations at 6,000 volts, which in turn were to deliver it to the rotaries at 83 volts alternating pressure, and this in turn delivered to the system at 125 volts continuous current. This primary current also was to enter direct the synchronous motors, directly connected to arc machines, and also apparatus whereby the three-phase, 6,000 volts, 25 cycles, was transformed into two-phase, 2,400 volts, 60 cycles, for secondary lighting.

With such a comprehensive system it was shown to be possible not only to shut down all the present stations of the Edison and Citizens' companies, but also to establish in the substations receiving current, good distribution in any form of current desired. The economies effected by such a system were great, in fact, so favorable did the proposition appear that

number of sub and semi-generating stations to be supplied from the new plant nine in number, the standard type for the future being that designated as sub-station "E," described above.

Upon the acceptance of this plan, property was purchased at the foot of 65th street, Bay Ridge, opposite Staten Island, on the line of the Long Island Railroad, having a frontage on New York Bay of 260 feet, and a depth of 500 feet. Upon this property was planned the erection of a station of 60,000 h. p., ultimate capacity, the erection of one-quarter of which was begun at once. Work was commenced simultaneously on this main generating station, three new sub-stations and on the changing of the four steam stations. On May 15 it was found that, all the underground work having been completed, as well as sub-station "E," it would be possible to start the system in a small way by stepping up from the low tension bus of the First District Edison station and transmitting the 6,600 volts thus obtained twelve miles to sub-station "E," Coney Island, and there step-down to supply the summer business in this territory. This plan was at once carried out, and on June 1, 600 h. p. were being distributed from this sub-station. This



THE NEW UNION STATION OF THE EDISON ELECTRIC ILLUMINATING CO., OF BROOKLYN, AT BAY RIDGE.
(Long Island Shore of New York Harbor.)

the work was immediately authorized by the directors and was started December 15, 1896. Actual work on the building of the bulkhead, piers and foundations was commenced on March 15, 1897. The economy in the operation of the business of the company as based on the plan outlined above, can be seen by the local diagrams on page 21, which give the load of the individual stations and the combined load on the water front station.

As it was not deemed advisable to shut down all of the steam stations during the first year, provision was made for operating the two largest stations for eight hours a day during the winter months. In order to render the system more reliable and to guard against any interruption to service, which up to this time had been of the best, it was deemed advisable to install in the stations two large storage batteries, which would enable the service of either company to be maintained continuously for three hours, thus giving ample time to provide for increased service.

In addition to taking care of the load of the present stations of the two companies, the plan proposed included the erection of various transformer sub-stations throughout the city, which would contain whatever apparatus was necessary for supplying the immediate surrounding district. The sub-stations authorized at the outset were three in number, making the total

double conversion system was continued throughout the summer until the starting of the Bay Ridge plant, and aided materially in the shifting of the load from one station to the other in order that the new work might progress without interfering with the business of the company. The most difficult part of the undertaking was the shifting over to the new system the entire business of the company, occurring, as it did, during the heavy business season of the year.

UNION STATION.—BUILDING AND FOUNDATIONS.

The great Union Station, as indicated above, is located on the water front, facing New York Harbor, where it looms up as the first great landmark greeting the incoming Atlantic tourist, on the Long Island shore. The building is 206 feet long and 120 feet wide, of composite brick and iron construction. The foundations of the building, consisting of a bed of concrete three feet thick, rest upon 40 ft. piles.

Longitudinally through the center of the building, and underneath the bed of concrete, are built two large tunnels, the masonry resting upon pile foundations. The dimensions of these tunnels are 9 feet 9 inches high by 6 feet 8 inches wide, and at the lowest tide they are flooded with six feet of water. The mouth of each tunnel extends out into New York Bay a distance of 50 feet from the building, and at this point they

are protected by heavy copper wire screens. The purpose of these tunnels is to have water directly under each engine without requiring suction, the condensing apparatus of the engine taking the water from one tunnel, through the surface condenser, and discharging it into the other. This arrangement has somewhat of a siphon effect, reducing to a large extent the energy required for the circulation of the condensing water, and at the same time rendering each engine or section of engine independent.

Upon the concrete foundation, mentioned above, were placed heavy granite pedestal stones, and upon these rest the iron columns supporting the framework of the structure. The brick filling-in walls average about 18 inches in thickness, and on the inside of the building are finished in compressed brick, which is in turn painted. The exterior of the building is finished in common brick, the panels being relieved by the use of washed brick. The roof of the structure is covered with slate on wood, resting on iron framework. Extending the length of the building, and through its center, is a turreted skylight, 20 feet in width, 206 feet in length and about 7 feet high at the ventilators.

The interior of the building is divided longitudinally into two parts by a curtain wall extending from the foundations to the roof, about 90 feet in height by 200 feet in length. The two rooms thus formed are the engine and generator room, about 200x66 feet, and the boiler room, about 198 feet 6 inches x 46 feet 3 inches.

The engine foundations are built to a height of 17 feet above the foundations of the building, at which point is located the engine room floor, leaving a basement for piping, pumps, etc., 16 feet in height. The boiler room floor is placed at a level two feet higher than this, allowing a basement head room of 18 feet, to provide for economizers, etc.

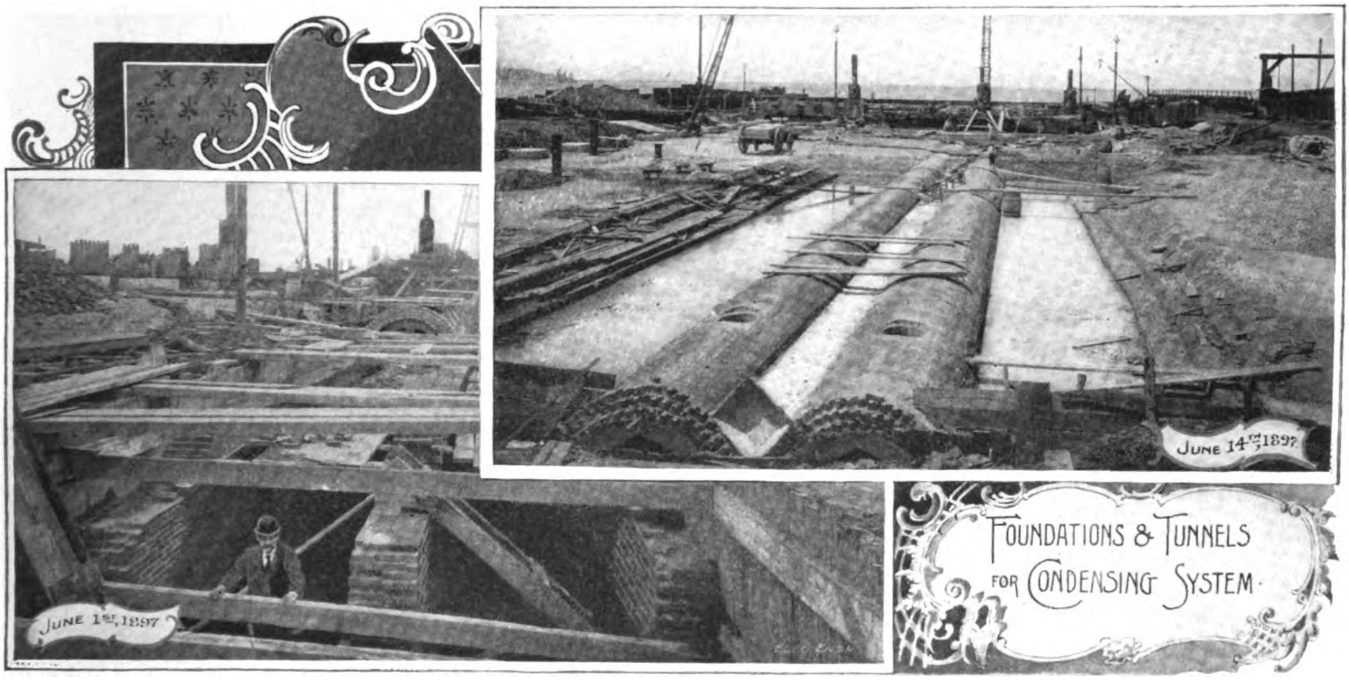
In the center of the boiler room, and against the curtain wall, are located the flues and stack foundation. From the stack foundation, which terminates 17 inches below the boiler room floor level, extends the steel smoke stack.

At the east end of the building, at a height of about 20 feet, above the engine room floor level, is located the switchboard gallery, at either end of which is a small room for the use of the attendants. Directly beneath the switchboard gallery, and on an intermediate floor, is built the high tension testing room and station superintendent's office. Below these, and on a level with the engine room floor, are the tool and toilet rooms. Beneath the engine room floor, and directly below the tool and toilet rooms, is located the high tension cable vault, into which are led all the alternating conductors, and from which they extend to the gallery and the underground conduits.

On the west end of the building, below the engine room floor, are located the wash rooms and shower sprays for the engineers and firemen. A spiral staircase extends from the roof of the electrical gallery to walks located on either side of the ventilator turret, thus enabling the ventilators to be properly handled and the windows to be cleaned. On the west end of the building and on a level with the ventilator walks, is built a large balcony overlooking the harbor.

Extending into the building, through a large door in the east end, is a railway switch from the Long Island Railroad tracks, and traveling longitudinally down the engine room, at a height of about 50 feet from the floor, is a three-motor Shaw electric crane, of 25 tons capacity. This equipment enables the company to deliver machinery into its building on the cars on which it is originally loaded, and to transfer it electrically from these cars to any part of the building for the purposes of erection with the aid of one operator in the crane. This crane, operated during the construction of the building by a temporary transformer station, enabled quick erection to be made, and to its use is largely due the completion of the entire plant in less than eight months.

The contractors on the station building, etc., were the following: John W. Ferguson, foundations and piling. Spearin & Preston, bulkhead and docks. John H. Parker Co., mason work, carpenter work, plumbing and painting. Milliken Bros., iron work. Thomas J. Lawler, smokestack. F. W. Miller, wells. Ansonia Copper Co., copper. W. J. Bolton & Co., trucking and erecting.



Foundations & Tunnels for Condensing System

ENGINES.

The building is laid out to contain 15,000 h. p. of horizontal engines, directly connected to three-phase generators. Provision has been made in the size of the property and the construction of the building for adding, either on the south side or on the east end of the present structure, so that the capacity of the entire plant, when completed, will be 60,000 h. p. Provision has also been made in the height and general arrangement of the building for using vertical instead of horizontal engines and increasing the boiler power, so that the present building capacity can be increased from fifteen to twenty-five thousand horse power, increasing the ultimate capacity of the company's property from sixty to one hundred thousand horse power.

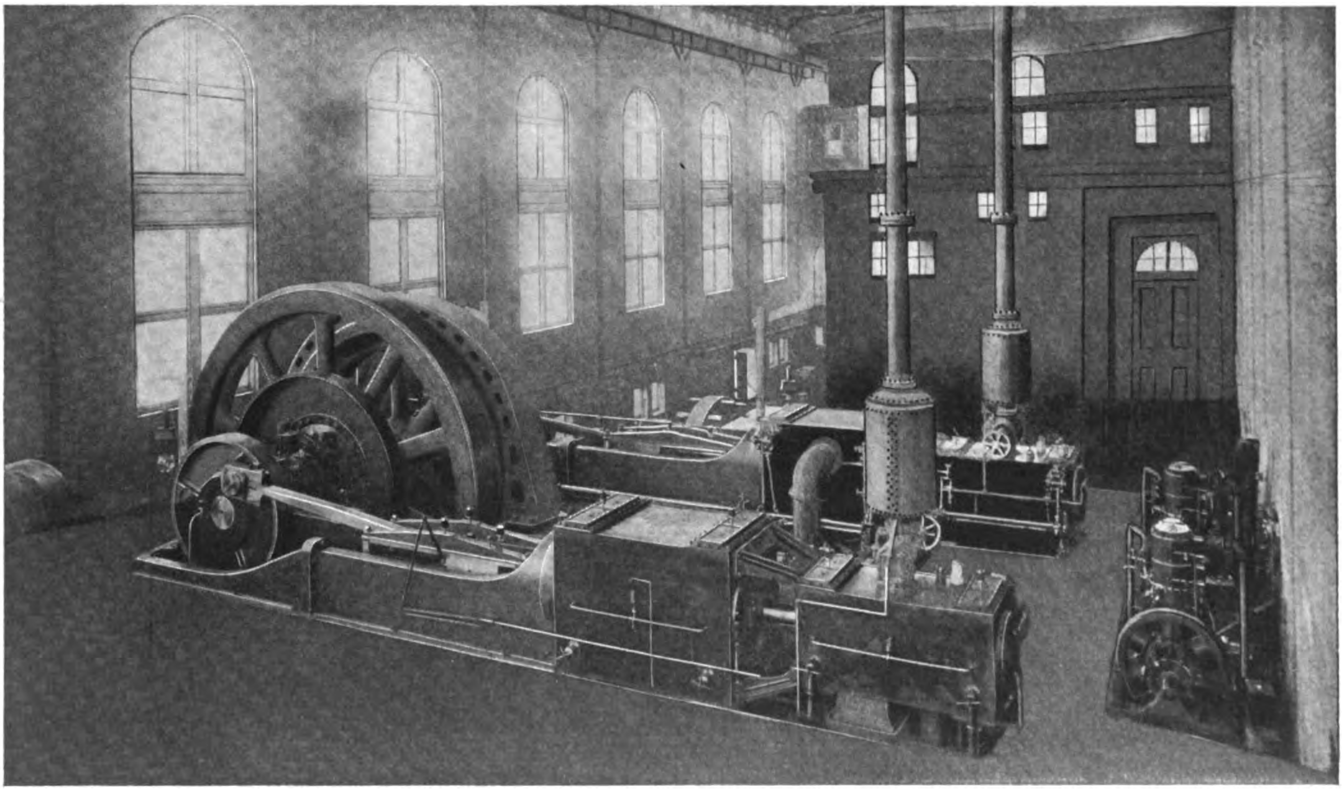
The unit decided upon for the plant was a 3,000 h. p. engine, directly connected to a 2,000 k. w. generator. A 1,500 h. p. Hamilton-Corliss engine, connected to a 1,000 k. w. generator, removed from another plant, is being installed temporarily in addition to the large engine mentioned above. This 3,000 h. p. unit the company will be able to keep fully loaded almost all the time on account of the consolidation of the present loads of its numerous stations and sub-stations.

The 3,000 h. p. engine, built and installed by McIntosh, Sey-

mour & Co., is of the tandem, twin compound horizontal side crank type, each side of the engine being independent of the other, and connected to independent condensing apparatus. The accompanying table gives the size and weights of the different parts of this magnificent engine.

DIMENSIONS AND WEIGHT OF McINTOSH, SEYMOUR 3,000 H. P. DOUBLE COMPOUND HORIZONTAL SIDE CRANK ENGINE.

Diameter of high pressure cylinder, 24 inches.
Diameter of low pressure cylinder, 48 inches.
Stroke, 66 inches.
Revolutions per minute, 75.
Initial steam pressure, 165 pounls, 26 inches vacuum.
Rated load in indicated horse power, 3,108; cut-off, 1/4.
At 6-10 cut-off, corresponding indicated horse power, 5,000; maximum cut-off, 8-10.
Total weight of engine, 605,000 pounds.
Directly behind the McIntosh, Seymour unit are located
Diameter of bearings, 24 inches; length, 42 inches.



DIRECT CONNECTED 3,000 H. P. THREE-PHASE UNIT, UNION STATION, BAY RIDGE.
(General Electric Co. Generator,—McIntosh, Seymour & Co. Engine.)

Diametef of shaft between bearings, 27 inches.
Diameter of crank pins, 13 inches; length, 11 inches.
Diameter of crosshead pins, 11½ inches; length, 11 inches.
Bearing surface of crossheads, 19 inches by 38 inches.
Diameter of piston rods, 7½ inches.
Diameter of steam pipes, 9 inches.
Diameter of exhaust pipes, 20 inches each.

This engine was designed and built upon specifications which called for less than one quarter of 1 per cent. variation in angular velocity, and this was deemed an advisable requirement in connection with the operation of rotary transformers, etc.

The generator, which is directly connected to this engine, is of the revolving field type and of 2,000 k. w. capacity. In order to enable units of this size to be operated without difficulty in parallel, an auxiliary arrangement was designed by the McIntosh, Seymour & Co., whereby, by the movement of a lever, the speed of the engine can be gradually increased or decreased while running without in any way handling the steam supply.

Directly beneath this engine, in the basement and between the engine cylinders and the tunnels, mentioned before, are located the circulating and air pumps, reheater and condenser, each side of the engine, as stated above, having its independent equipment.

The smaller unit which is being installed from another plant of the company consists of a twin compound, Hamilton-Corliss engine, of 1,500 h. p. capacity, directly connected to a 1,000 k. w. alternating current generator of the revolving field type. The dimensions and weights of this engine are as follows: High pressure cylinders, 26x48 inches; low pressure cylinders, 48x48 inches. Weight of engine without wheel, 160,000 pounds. Wheel, 18 feet diameter, built in sections; weight, 65,000 pounds.

There is also located in the engine room, directly behind the Hamilton-Corliss engine, a 300 h. p. triple expansion vertical, Lake Erie engine, built by the Lake Erie Engineering Works. To this engine is directly connected, to each end of the shaft, a 100 k. w. multipolar, 125-volt, General Electric generator. This combined unit is for use in conjunction with the auxiliaries, as described below.

Directly behind the McIntosh & Seymour unit are located two 50 k. w. General Electric multipolar generators, each with its directly connected compound vertical engine, these units being intended to act as exciters for the large generators.

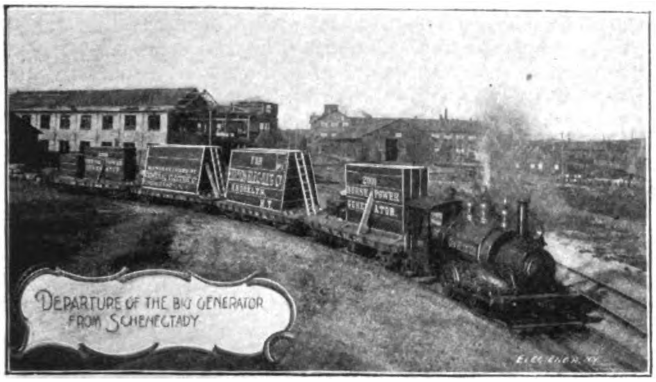
THE BOILERS, STOKERS, ECONOMIZERS, ETC.

The boilers are located with their rears to the curtain wall, this arrangement bringing them as close to the engine cylinders as possible, as shown on the sectional view in the accompanying supplement. The boilers are of the Cahall-Babcock & Wilcox "flowed" steel type, the contractors being Thayer & Co., Inc., of New York, and the builders the Aultman & Taylor Machinery Co., of Mansfield, O.

Each boiler, which is "double decked," has a nominal capacity of 500 h. p., and is made up of 36 sections, expanded into headers of "flowed" steel, each section having six 4-inch tubes, 18 feet long. These various sections are joined to three 36-inch steam drums, the length of the drums being 22 feet 6 inches. These drums are made of O. H. steel, having a tensile strength of 60,000 pounds per square inch of section, 7-16-inch thick, with longitudinal seams; butt strap joints, treble riveted. The boilers are designed to work safely up to 200 pounds pressure.

The boilers are equipped with American end feed, forced

draft stokers, built by the American Stoker Co., of Brooklyn, N. Y., three stokers, independently driven, being installed for each furnace, or six per battery. These stokers consist simply of a trough, or magazine, in the bottom of which a screw or worm is kept revolving by means of a small steam motor requiring 1-5 h. p. to operate. The coal which is fed to a hopper situated in front of the boiler passes into the magazin: end, is



Departure of the big generator from Schenectady

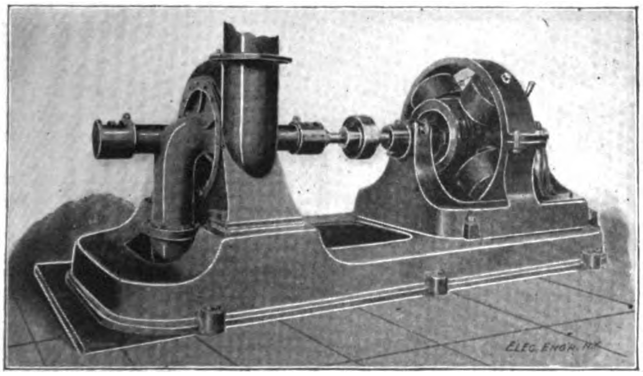
forced upward by means of this worm and rises to a height of 18 to 24 inches and falls to either side of the magazine, covering the entire grate surface. The necessary air for combustion is admitted to each stoker from the underside and meets the fuel through a number of tuyeres arranged around the magazine near its top.

The air storage for the various stokers consists of a 36-inch galvanized iron main located underneath the boiler room floor and in which an average pressure of two ounces is maintained by three Sturtevant blowers, electrically driven.

The boilers are connected by iron pipe bends with the cast steel header, extending longitudinally over the boilers, and resting upon independent iron framework, immediately adjoining the curtain wall. From this header is taken the live steam supply to the engines. The piping was installed by Best, Fox & Co.

Gate valves are located in this header for the sake of safety and reliability. This is the only steam piping in the entire station. Valves were furnished by the Chapman Valve Mfg. Co., Kennedy Valve Mfg. Co., Jenkins Bros., and John Acton.

Beneath the boiler room floor, and under the rear of the boilers, next to the fire brick flue, are located the Green economizers, so arranged as to provide for positive or natural circulation as may be desired. The front of each economizer is fitted with a sectional sheet iron filled cover so that any portion of the cover may be taken off and examination made of the sections of the economizer, and any section taken out without disturbing any other part of the economizer or dis-



KNOWLES CENTRIFUGAL PUMP DRIVEN BY ELECTRIC MOTOR.

turbing the brick work. These economizers were furnished by the Fuel Economizer Co., of Matteawan, N. Y.

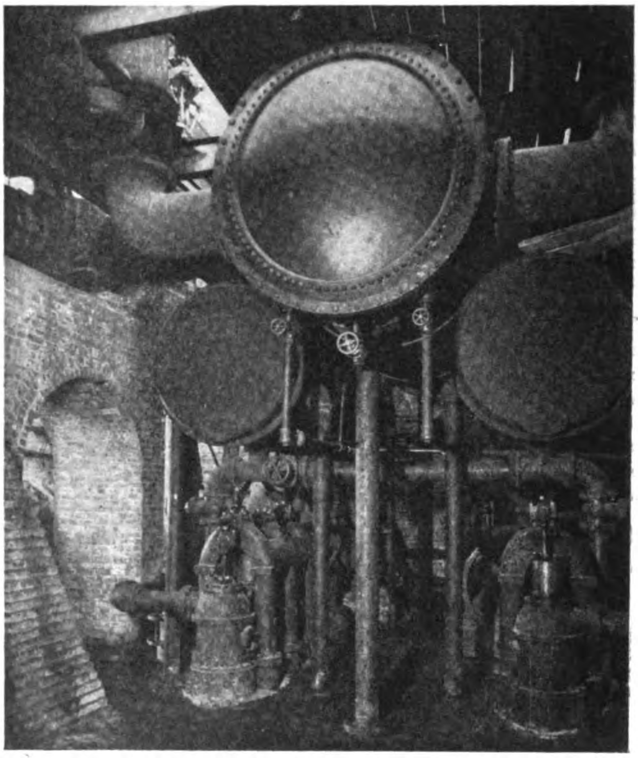
Beneath the boiler room floor, directly under the passage of the front of the boilers, are placed the boiler feed auxiliaries, blowers for the automatic stokers, and also the deep wells, used for the supplying of boiler feed water.

Quite a departure has been made in the design of this station by the adoption of electric auxiliaries throughout, steam being used only for the three engines, above mentioned, and a small air pump for compressed air. The circulating, air and boiler feed pumps are directly connected to multipolar low speed motors.

The circulating pumps are of the Knowles centrifugal type, illustrated on this page, directly connected to a G. E. multipolar motor by insulated coupling, and run at a speed of 600 revolutions, with a capacity of 3,000 gallons per minute. Two of these units are used for the 3,000 h. p. engine and one for the 1,500 h. p. and 300 h. p. engines.

The air pumps are of the Worthington steeple, three-plunger type, directly connected by means of one set of gears to a multipolar slow speed G. E. motor, running at about 300 revolutions. Two of these units are used for the 3,000 h. p. engine and one for the 1,500 h. p. and 300 h. p. engines. Each group comprises a circulating and air pump, directly connected by short piping with a Worthington surface condenser, which is located immediately beneath the low pressure cylinder, allowing, however, for suitable by-passes to free exhaust, and also for the introduction of a 2,000 h. p. vertical Goubert heater, which is placed on either side of the engine in the basement.

The speed of these air and circulating pumps is controlled



3,000 H. P. CONDENSING EQUIPMENT, UNION STATION.
(Worthington Pumps and General Electric Motors.)

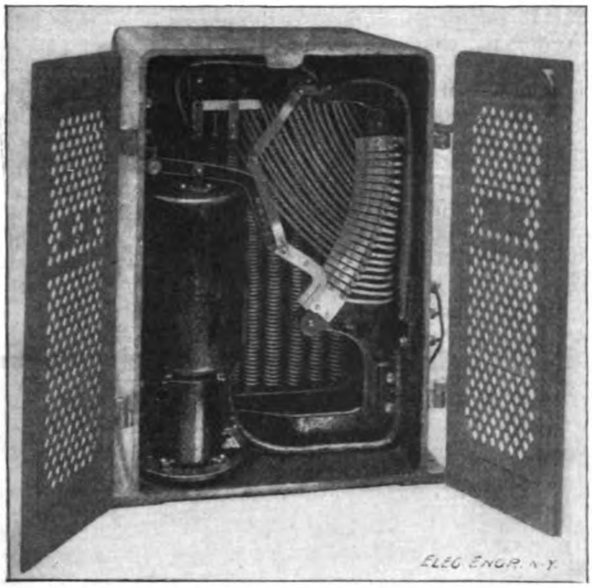
from the engine room floor by means of a See field resistance, page 18, which is cut in and out of the field circuit motors, and the equipment is so arranged, even to its oil system, as to require no attention whatever beyond an occasional inspection.

The total circulating water piping for each unit of 1,500 h. p. does not exceed 12 feet in length, there being but five joints. The total connection of the air pump piping is about 14 feet long. The total length of the piping between the low pressure engine cylinder and the condensers, including the piping to the heaters for each unit, does not exceed 20 feet in length, there being not more than seven joints. As will be seen from the above, special attention was paid to short connections.

The boiler feed pumps are of the Worthington horizontal, three-plunger type, directly driven by means of one set of gears by a G. E. multipolar, slow speed motor, running at 250 revolutions. The speed of each unit is varied from the boiler room floor by means of governing resistance cutting in and out of the field circuit. In addition to this, the starting and varying of the speed of the motor is done automatically, depending upon the pressure of the feed pipe system. Each boiler feed pump is directly connected to the feed system, which passes through Goubert heaters and auxiliaries into the main line, from which are taken the feeds to each boiler, and which feeds are con-

trolled by the firemen by ordinary hand valves. Suitable by-passes are arranged for each piece of apparatus, so that any system of feed is provided for.

The suction of the feed pumps is connected to a main, directly connected to a number of driven wells, which are the main source of water supply, and also to two large water tanks, where all particles of sand or suspended matter can settle. These tanks are supplied from the wells by a direct connected electric

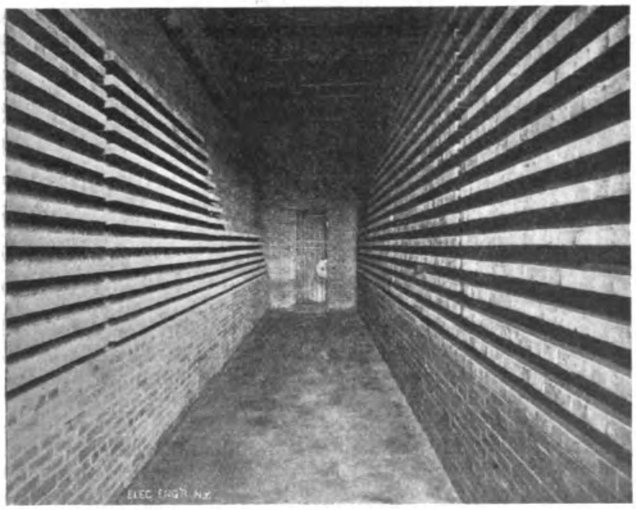


RHEOSTAT FOR CONTROLLING AUXILIARIES.

Deane duplex pump, of 300 gallons capacity. Into the tanks are also connected all the leaders of the building by means of a by-pass, so that rain water can be used as boiler feed during heavy storms.

The Sturtevant blowers, which supply air to the stokers, are secured to the ceiling of the basement, or the underneath side of the boiler room floor, and are directly connected by belts with slow speed multipolar motors.

All motors, above described, used for auxiliaries, blowers, etc., are of the General Electric 230-volt type, and are supplied with current from the vertical, triple Lake Erie engine unit.



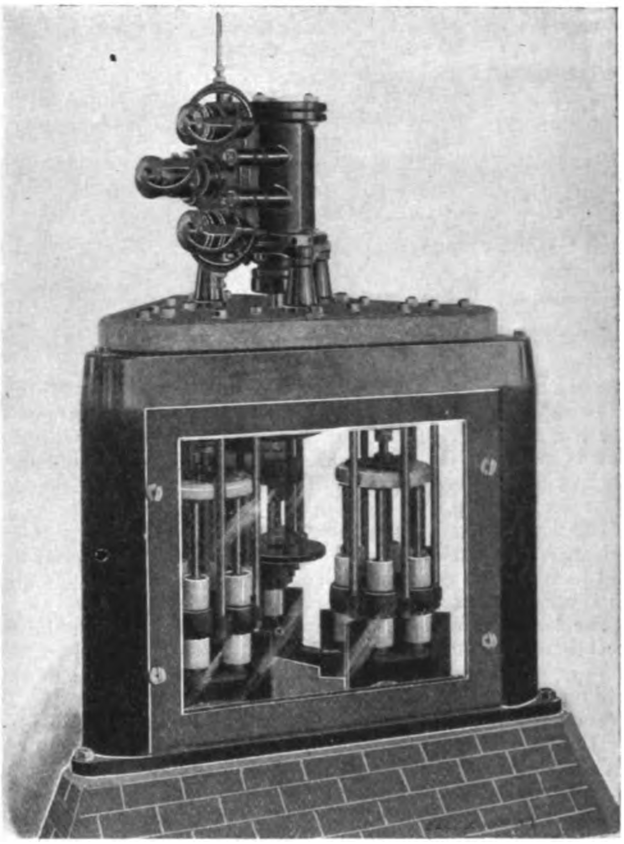
HIGH TENSION VAULT SHOWING FIREPROOF SHELVING FOR CABLES, UNION STATION.

before mentioned. Thus there is no steam device,—excepting a small steam air pump,—which has a lower economy than 16 pounds of steam per indicated h. p., which is the economy of the Lake Erie engine under full or three-quarter load, at which load it will always be operated.

This arrangement of electric auxiliaries enables the auxiliary equipment of the station to be ruduced from 12 to 40 per cent., as regards steam economy.

AIR AND OIL SYSTEM.

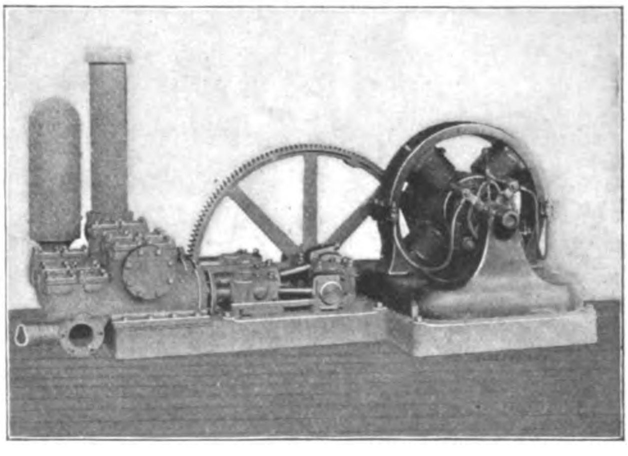
Compressed air at 40 pounds per square inch is used in the Union Station for the blowing out of boiler tubes (in place of steam, as formerly), for cleaning all the electrical equipment, for handling the oil and for the operation of the pneumatic electric switches described below. To render this part of the plant as reliable as possible, the air is compressed by direct con-



6,600-VOLT ELECTRO-PNEUMATIC SWITCH.

nected air pumps, supplied directly from the main steam line, the air being stored in two tanks, one located in close proximity to the electrical gallery for use at that point, and the other in the boiler room. The air compressor was furnished by Westinghouse, Church, Kerr & Co.

The oil is supplied to each engine by positive feed pumps,



WORTHINGTON TRIPLEX BOILER FEED PUMP, DRIVEN BY GENERAL ELECTRIC MOTOR.

operated from the engine, and is discharged, after use, into tanks connected with filtering apparatus, and is then lifted, by means of compressed air, into the main tank which supplies the engine pumps. Besides this system, facilities are provided for hand oiling. All motors throughout the plant have self-oiling

bearings, and the pumps are equipped with grease cups, so as to render little attention necessary.

THE SMOKESTACK.

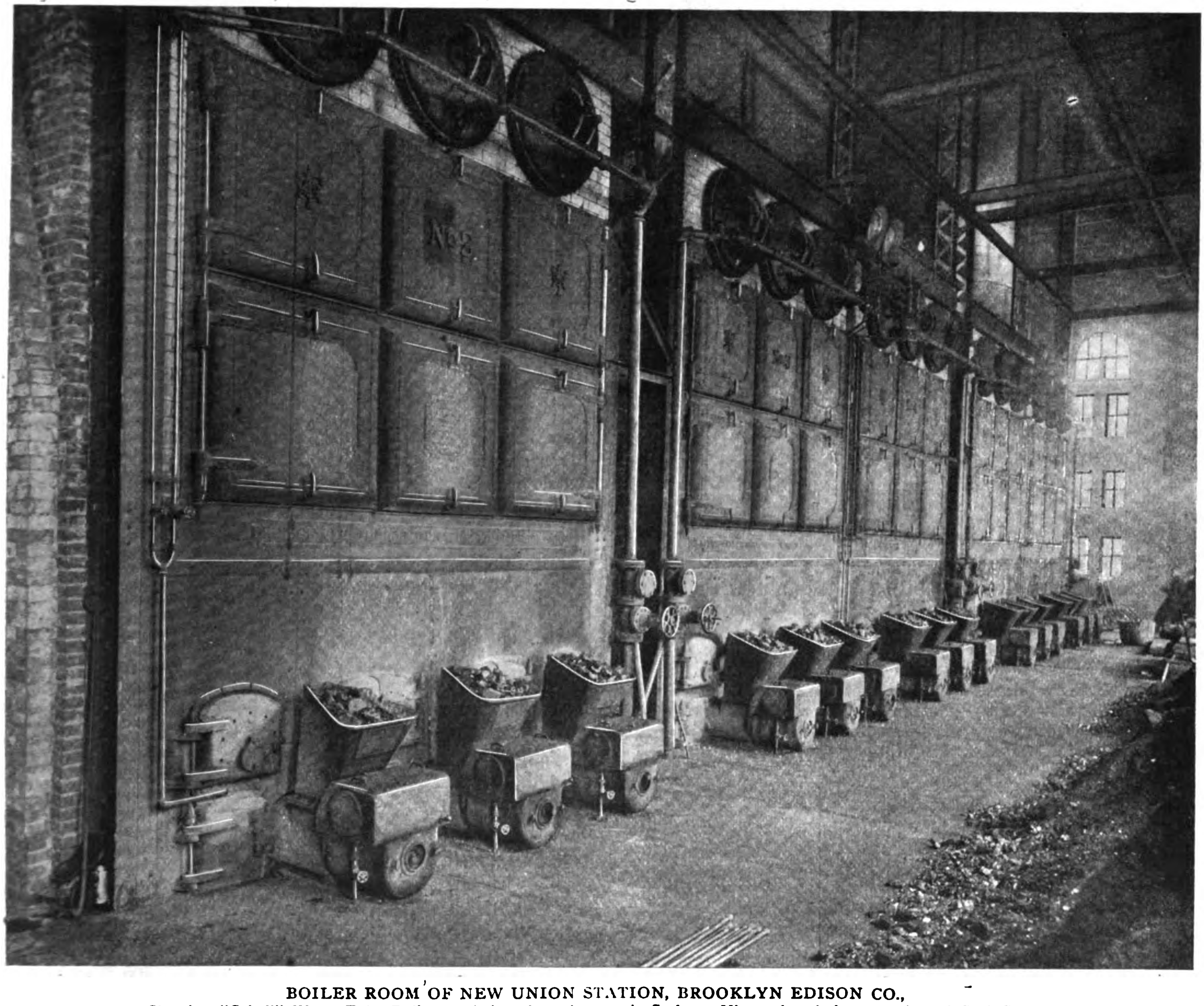
The stack, which is constructed of steel, and is the tallest of its kind in the country, rests upon a foundation of brick, into which the flue openings are made. The base of the stack measures 25 feet in diameter and is bell shaped to about 25 feet in height, where the diameter is reduced to 15 feet 6 inches. From this point to the top the stack tapers gradually to 12 feet. Its total height is 240 feet, the plates used in its construction varying from ⅝-inch thick at the base to 5-16 at the top. The stack throughout is lined with Sayer & Fisher "A.1" fire brick, backed by red brick. The supplement accompanying this number gives detail drawings of the stack.

COAL STORAGE AND COAL AND ASH HANDLING MACHINERY.

Extending out from the southern part of the water front of the company is the coal pier, shown on page 20, built to accommodate vessels of any length and draught. On this pier travels an unloading tower which is operated entirely electrically by one man. The electric hoist, operated on the Leonard system, removes the coal from the boat on either side of the pier with a one-ton shovel and deposits it in a hopper in the center of the tower. The coal then falls by gravity on to the crushing rolls, which are driven continuously from a motor dynamo which supplies the hoist above. From the crushers the coal passes to a Clarke self-weighing and self-feeding scale, which automatically records the weight of the coal on a dial. From the scale the coal descends into a cable car located beneath the tower and running on tracks laid on the pier.

The tower is capable of moving lengthwise to the pier, so as to render it possible to unload coal at any point on either side of it. From the tower the coal is conveyed by means of a shuttle cable road up an incline to a 2,000-ton coal storage bin, located about 300 feet back of the tower and 60 feet south of the main building. The motor operating this shuttle road is automatically stopped and started by the weight of the coal that drops into the cable car, and in the following ingenious manner:

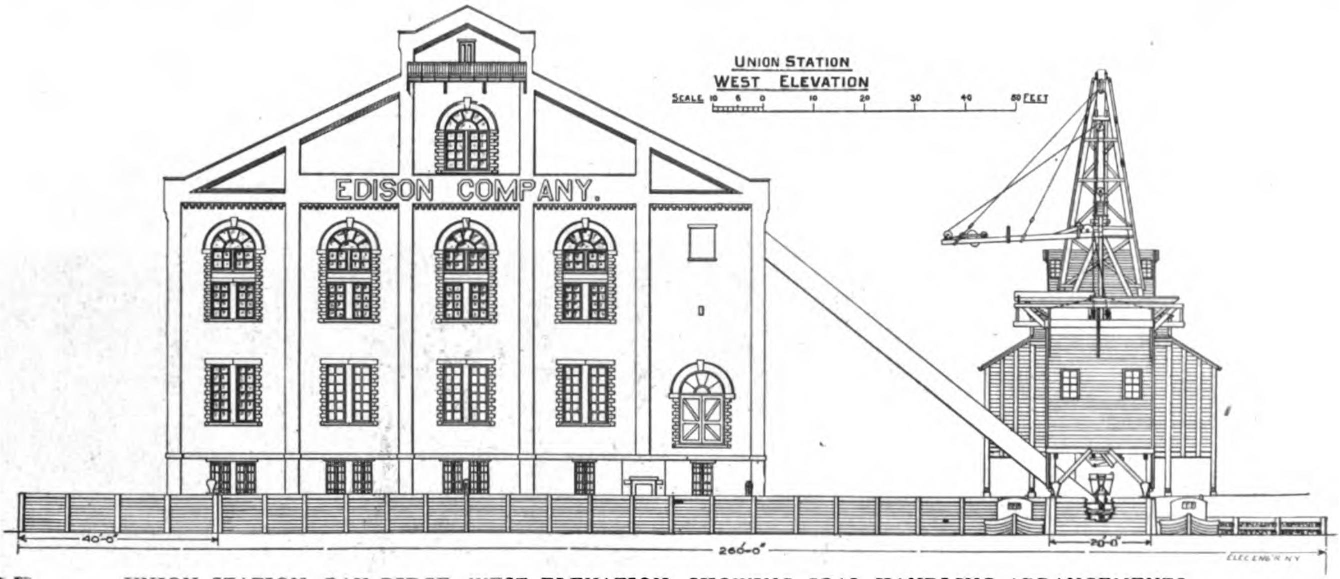
Each car when loaded to a certain point settles on its springs and makes contact with a third rail. The cable drum is thereby started and the car moves to the main storage bin. In moving forward it closes the chute through which it was filled, which chute remains closed until the empty car which returns to the dock as the loaded one moves from it, opens it again. The loaded car empties itself at any point desired; the car thus emptied is raised in its springs, breaks the circuit and is stopped. The operation is repeated when the car, which is now being filled, again makes contact with the third rail. The arrangement is thus entirely automatic.



BOILER ROOM OF NEW UNION STATION, BROOKLYN EDISON CO.,
Showing "Cahall" Water Tube Boilers and American Automatic Stokers. View taken before erection of Coal Conveyers.

The coal storage is a wooden structure, 100x40 feet, and 30 feet high, proportioned and built for the storing of 2,000 tons of soft coal. Under the pocket, and for its entire length, runs a conveyor of the Link Belt type, installed by Mr. Augustus Smith; this conveyor takes the coal from the various chutes and deposits it into another conveyor, which, carrying it up an incline of 30 degrees, transfers it to a third con-

veyor, which deposits it into hoppers over the boilers, which have a capacity for two days' supply. This arrangement is shown in the sectional view in the accompanying supplement. From these hoppers the coal passes down a chute and through a self-weighing scale (one for each battery of boilers) into a small distributing screw conveyor, which feeds it to the stokers.



: UNION STATION, BAY RIDGE, WEST ELEVATION, SHOWING COAL HANDLING ARRANGEMENTS.

Thus the entire operation from the unloading of the coal on the tower to the burning of the coal in the furnace is performed automatically. The coal unloading machinery was installed by Messrs. John A. Mead & Co.

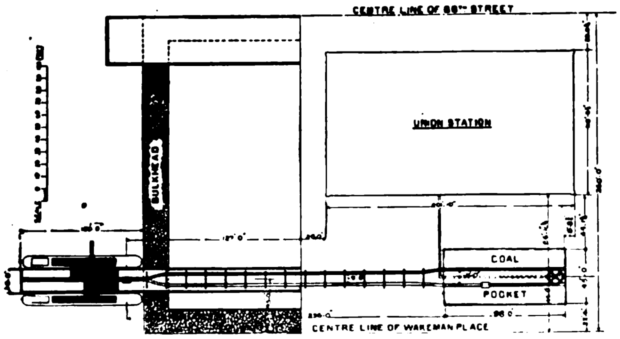
In front of the economizers, and under the furnaces of the stokers, are placed the ash receiving hoppers, beneath which runs an ash car the entire length of the boiler room, and through a bin in the west end of the building, to a point between two bulkheads, where the ashes are used for filling-in purposes.

THE OVERHEAD TRAVELING CRANE.

For convenience during construction and in making of repairs, should any become necessary, there has been erected in the engine room an electric crane built by the Shaw Mfg. Co. This crane, which has a capacity of 25 tons, spans the engine room, a width of 68 feet, and travels its entire distance. It is designed to move at a speed of 200 feet per minute. The trolley moves horizontally 80 feet per minute, and the hook rises or falls at a speed of 50 feet per minute. These movements are effected by three electric motors. All supplies for the station may be run into the building on flat cars over a specially constructed trestle, whence the crane may move them to any point desired.

THE GENERATORS AND MOTORS.

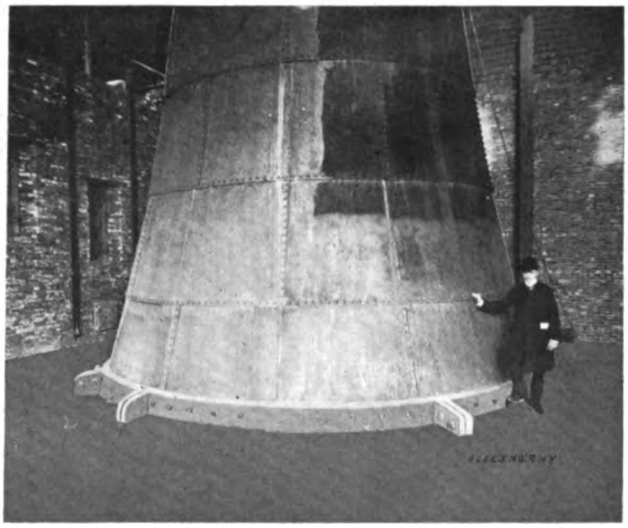
The present main generators of the station are two in number, and are of the three-phase, high voltage type. These machines are of the General Electric revolving field, standard armature construction, the fields being excited with current at 115 volts pressure by means of small collector rings placed on the shaft. The capacities of the machines are 2,000 and 1,000 kilowatts, respectively, with an allowance of 25 per cent. for overload. A voltage of 6,600 volts is delivered directly from the armature at a speed of 75 revolutions per minute, without step-up transformers.



GENERAL PLAN OF COAL HANDLING ARRANGEMENT.

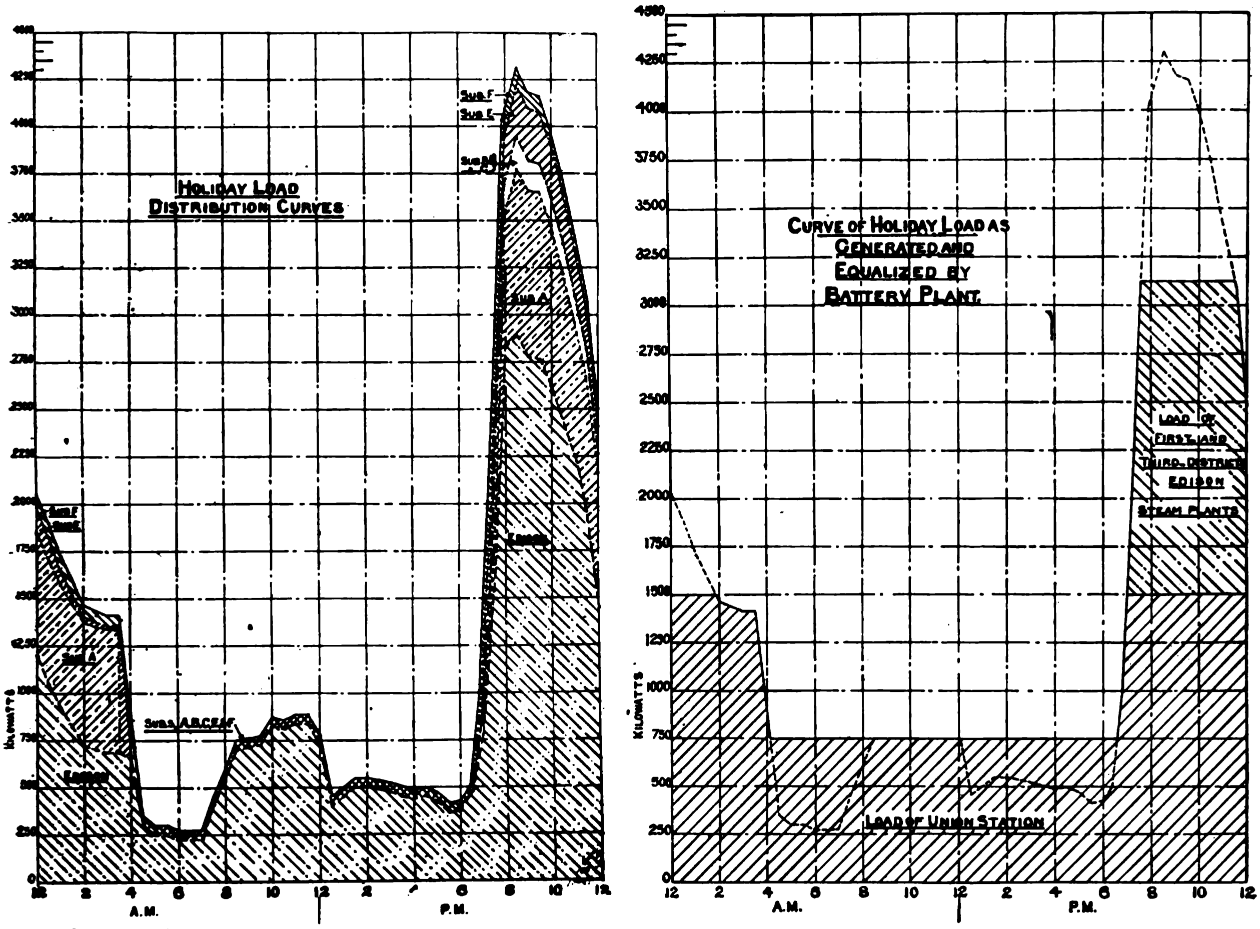
This great dynamo was not designed simply to give its rated output without injurious heating, but rather with a view to obtain the maximum economical efficiency; that is, a comparison was made between the interest on its first cost and the cost of its operation, and a design adopted which would conduce to the maximum general economy. Some of the most interesting features of this machine are the following:

The armature laminations are mounted on the interior of a box frame of very great rigidity, openings for ventilation being provided at intervals. The armature coils are placed in slots in these laminations and held in place by wooden wedges. The method of insulation of these coils has been very carefully worked out; the insulation of each coil is wound on the coil itself, practically no slot insulation being used. The machine has been tested in the General Electric Co.'s factory with 30,000 volts alternating potential difference between the winding and the iron. The armature frame is illustrated in the initial "O" at the head of this article.

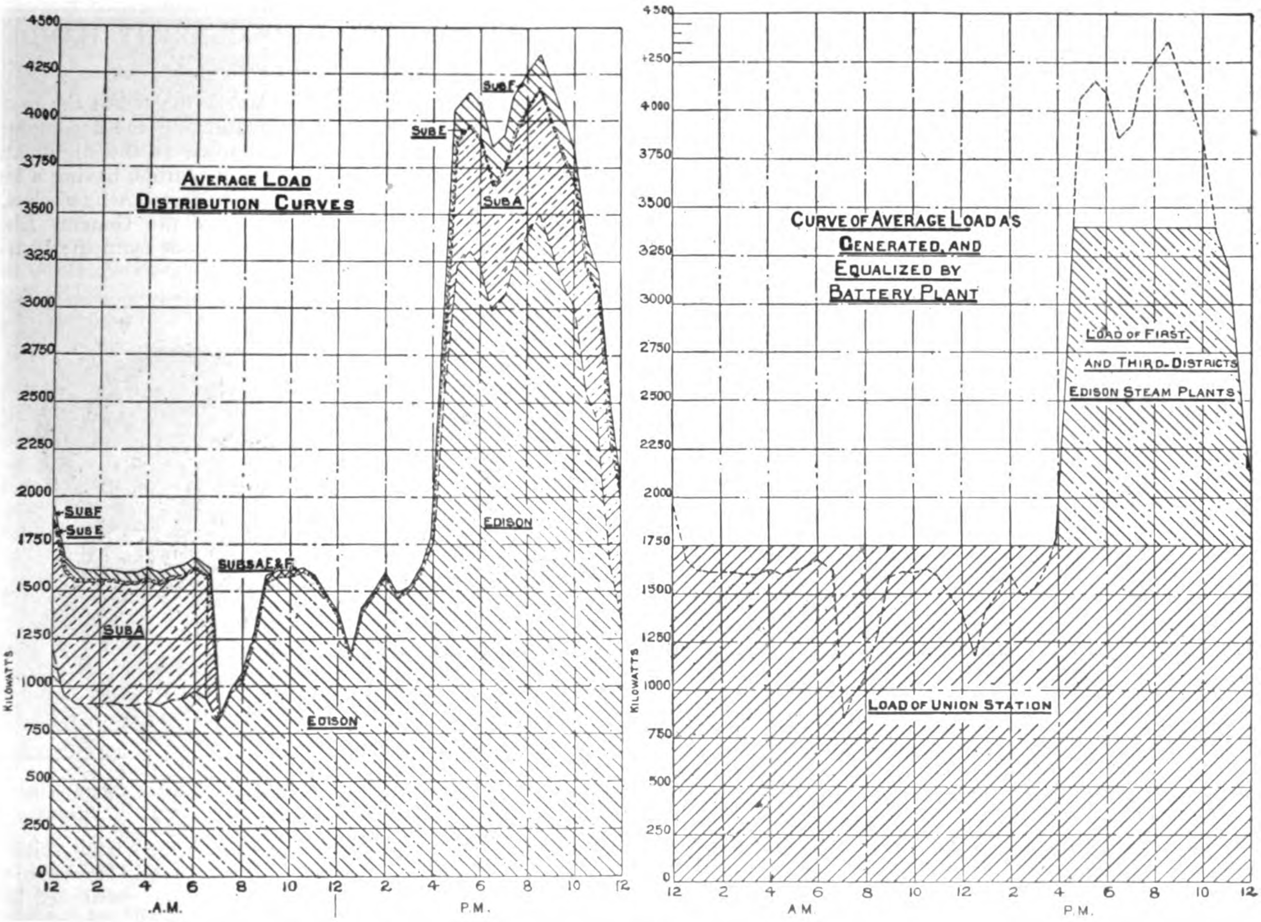


BASE OF GREAT SMOKE STACK, UNION STATION.

The field structure consists of a cast iron spider which carries a steel ring; this steel ring is cast and finished smooth. The pole pieces are built up of laminations and are bolted to this steel ring. The field coils are placed upon the pole pieces before they are attached to the ring, each coil consisting of a spiral of strip copper wound on edge, the successive turns being insulated from one end by paper. This makes an extremely compact coil, practically indestructible, since the heat is not



CURVES SHOWING HOLIDAY LOAD DISTRIBUTED ("A"), AND AS EQUALIZED BY STORAGE BATTERY ("B.")



CURVES SHOWING AVERAGE LOAD DISTRIBUTED ("C"), AND AS EQUALIZED BY STORAGE BATTERY ("D.")

at all confined by the insulation; the coil remains at practically the same temperature throughout its mass and runs very cool. The field is excited with a direct current at 125 volts, this current being delivered through a pair of collector rings on the shaft. Carbon brushes are used on these collector rings, and the arrangement is such that they require little or no attention.

The armature structure of this machine is mounted on cast

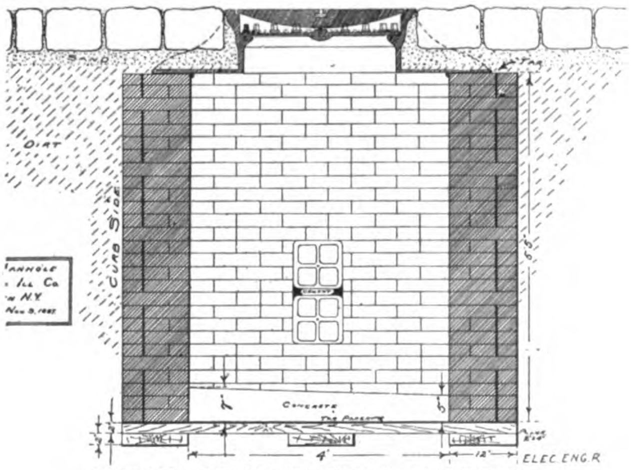
McROY CONDUIT FOR HIGH TENSION CABLES.

iron rails attached to the foundation. It is so arranged that it can be slid along on these rails into a position where its coils clear the field coils. When in this position any of the coils of armature or field can be removed and replaced. The following are the principal dimensions of the machine: Outside diameter of armature frame, 21 feet, 2 inches; outside diameter of revolving field, 16 feet, 7⅜ inches; distance between rails, 25 feet 5½ inches; length of rail, 7 feet 3 inches; diameter of shaft, 27 inches; height above floor line, 13 feet 10 inches.

This machine is wound for 6,600 volts, that being the voltage used in transmission. Its design is such that it can be built for a very much higher voltage.

THE AUXILIARY ELECTRIC EQUIPMENT.

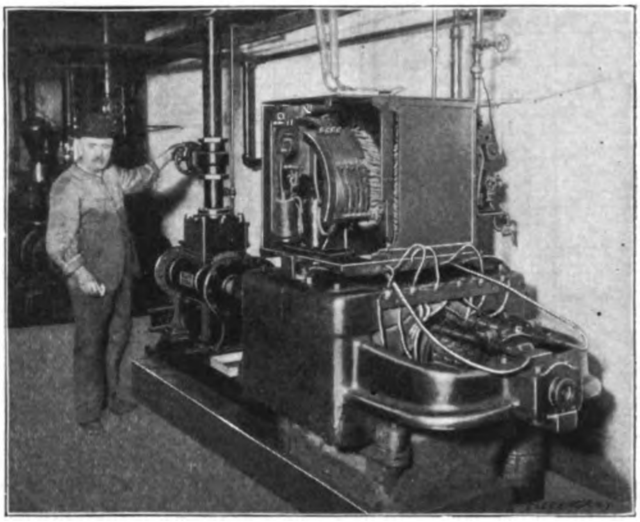
This consists of two multipolar General Electric exciters, each directly connected to the shaft of a vertical compound engine, running at 400 revolutions. These exciters are wound to



SECTION OF WATER-TIGHT MANHOLE.

give 125 volts at 400 amperes each. There are also two multipolar General Electric generators, direct connected to the vertical triple expansion Lake Erie engine, wound for 150 volts and 666 amperes, at a speed of 175 revolutions. These two generators are connected on a three-wire system and used to operate the 230-volt auxiliary equipment of the plant, and also to furnish the lighting.

The multipolar motors running the blowers for the automatic stokers are of 25 h. p. each, at a speed of 580 revolutions. The multipolar motors used for operating the circulating pumps are of 20 h. p. each, at 610 revolutions; while the motors used for operating the air pumps are 15 h. p. each, at 260 revolutions. The multipolar motors used for operating the boiler feed pumps are of 20 h. p. each, at a speed of 280 revolutions, and those

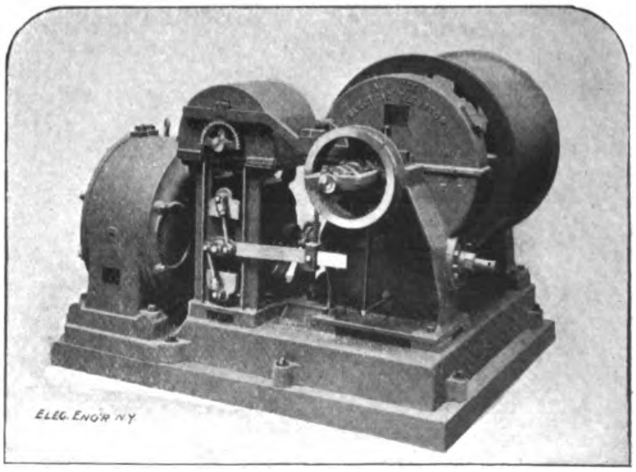


OTIS-QUIMBY ELECTRIC ELEVATOR PUMP.
(In Municipal Building.)

used for operating the coal conveyor system are multipolar machines of 5, 10 and 15 h. p. respectively, while the coal hoisting tower is operated by a 100 h. p. motor, supplied by a 65x55 k. w. motor-generator on the Leonard system. The C & C motor operating the well pump is of 20 h. p. at a speed of 1,000 revolutions, and is directly connected to the pump by means of a double screw gear of the Whittier type. All these motors, excepting that on the well pump, are of the General Electric type.

THE SWITCHBOARD AND CURRENT HANDLING ARRANGEMENTS.

The main switchboard of the plant is located at the east end of the building, shown in the elevation on the accompanying supplement. This switchboard, known as the high tension, three-phase board, is of blue Vermont marble, having a length of 49 feet 6 inches and a height of 12 feet. All switches, excepting as hereafter mentioned, are of the General Electric knife blade, quick-break type, mounted out from the board on



A. B. SEE TWO-PHASE ELECTRIC ELEVATOR.

corrugated rubber insulators. The ammeters and voltmeters are of the Thomson inclined coil type, and Thomson wattmeters are used on all electrical generators mentioned below.

The switchboard has a space immediately in front of it of 50x

6 feet, while back of it is a room 10x50 feet. In this room are located the field rheostats for the large alternators, connected by means of cables and a regulating head, mounted on the switchboard itself. The switchboard is provided with three buses, and knife blade switches are used in changing from one bus to the other. The entire switchboard, consisting of 12 panels, is divided into seven feeder and five machine panels. The board was built at the works of the General Electric Co.

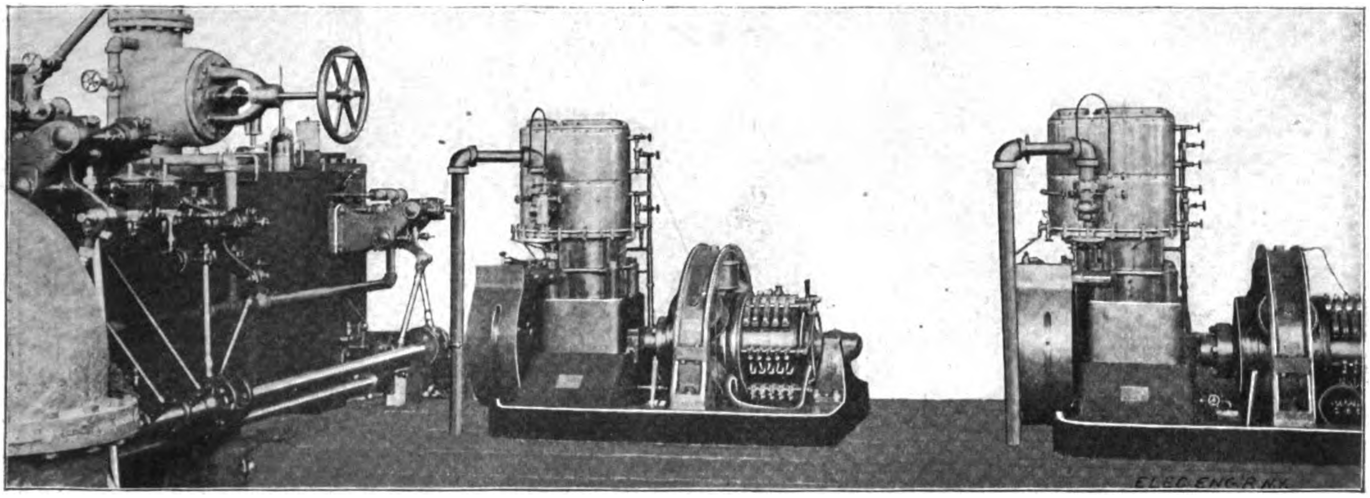
Electro-Pneumatic Switches.—Behind the board, in the room above mentioned, are four 7,000-volt electro-pneumatic cylinder switches, mounted on brick pedestals, as shown on page 18. One of these switches is placed in the main circuit of each generator, while the other two are connected between the busses to be used for synchronizing. These switches are the first efforts to combine the reliable pneumatic devices of the Union Switch & Signal Co. with the high tension electrical switch, manufactured by the General Electric Co.

The electrical portion of the switch consists of a three-armed spider, each arm carrying a number of plungers, which make contact inside of porcelain tubes. A group of contacts is placed in each wire of the three-phase system. The three groups are operated simultaneously by means of the three-armed spider, connected to an electro-pneumatic motor of the piston type, operated on an air pressure of 40 pounds, and controlled electrically by means of a small switch on the front of the switchboard.

The wiring from the auxiliary switchboard to the different auxiliaries of the station consists of solid copper rods with three-wire braid covering, suspended by specially designed porcelain clamps, making a rigid piece of work of pleasing appearance. These conductors terminate at specially designed automatic resistance boxes, so that the starting of each motor is accomplished by simply closing its main switch. Thomson wattmeters are provided for every part of the electrical equipment. Each three-phase generator is connected to a 6,600-volt alternating current wattmeter, and each direct generator is connected to a 125-volt Thomson wattmeter, this arrangement providing for the metering of all current generated by the plant. In addition to these, there are wattmeters on each consumption circuit in the station, so that the power consumed by the auxiliaries, coal handling equipment, etc., can be easily ascertained.

STATION LIGHTING.

The lighting of the main engine room is accomplished by means of ornamental lamp posts, built by the General Incandescent Arc Light Co., upon the top of which are placed enclosed arc lamps of the General Electric type. These lamp posts are adjustable from the floor, slipping into sockets, thereby rendering it possible to instantly shift them if necessary, or to remove them for the purpose of handling parts of the equipment with the crane. The boiler room is lighted by



DIRECT CONNECTED EXCITER UNITS, UNION STATION.

On the front of the switchboard gallery, and immediately in front of the generator panels, are located seven black enameled slate field rheostat boxes controlling seven exciters, four of which are at present installed. On the top of these boxes, supported on brass stands, are the direct current voltmeters and ammeters for the exciters. Small baby knife switches on the sides of the boxes operate the electrically controlled switches on the auxiliary switchboard, described below.

Auxiliary Switchboard.—An auxiliary switchboard of black marbleized slate is located on the engine room floor in the west portion of the building, immediately back of the vertical triple expansion engine. On this board are mounted electric switches of 1,000 ampere capacity, controlling circuits for exciters, pumps, lighting, etc., and operated by small secondary circuits from the high tension switchboard, above mentioned. This arrangement obviates the necessity of carrying heavy copper cables a distance of 230 feet, and return, for the sake of connecting and disconnecting them, and at the same time puts the handling of the entire electrical equipment of the plant in the hands of the switchboard operator. The switches on these boards were furnished by the General Electric Co.

Station Wiring.—The cables leading from the generators to the main switchboard are drawn through glazed tile duct, of the McRoy and Camp type, which ducts are built into the walls of the building. Where they pass through the vault they rest upon brick shelves, formed by building ordinary brick into alternate layers of headers and thick courses. This arrangement does away with all insulators for supporting the cable, and provides a fireproof compartment for each separate three-wire cable. Seep age 18.

enclosed arc and incandescent lamps, which also take care of the coal storage, unloading tower, etc.

It is the purpose of the company to provide for all further increase of exciter or auxiliary current by means of rotary transformers, as it was not deemed advisable to introduce them in the main station at the outset.

TRANSMISSION AND DISTRIBUTING SYSTEMS.

All the current generated at the Union Station is transmitted to the different stations and sub-stations by means of duplicate underground three-wire lead-covered cables, drawn through McRoy earthenware ducts, all joints being made in moisture-proof manholes; a section of one of the latter is shown on page 22. All cables were furnished by the Standard Underground Cable Co., and are of paper and compound insulation. All sections of cable were tested at the factory in accordance with the specifications by a representative of the Edison Company for one hour with from twelve to fifteen thousand volt alternating current, and a test was also made after the entire system had been completely laid by the contractors. These cables comprise 30 miles of three-conductor, ranging in size from No. 4 to No. 6 B & S.

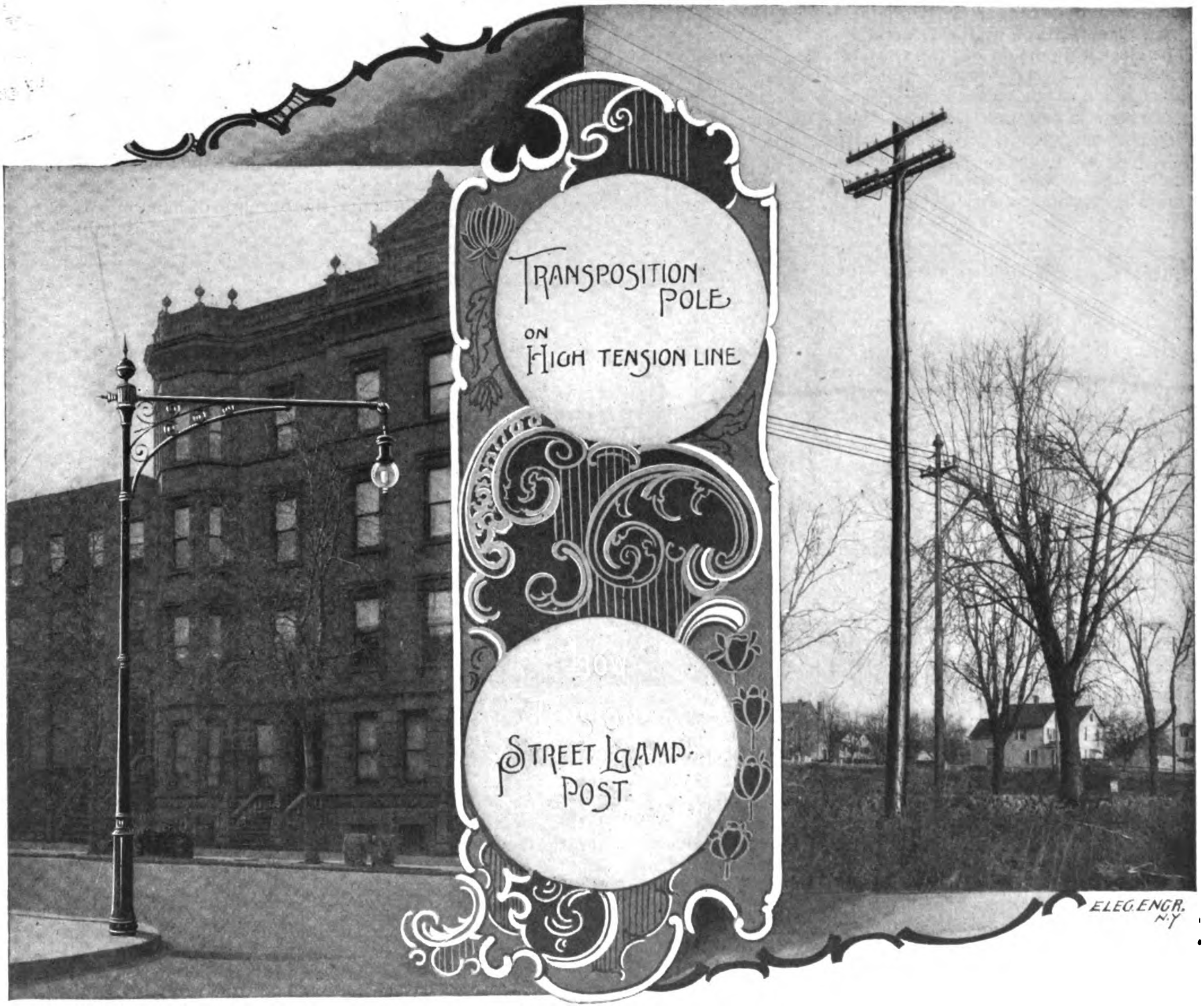
The low tension distributing systems are made up of the familiar Edison three-wire system, the conductors being of copper rods in iron pipes, insulated in the usual manner by compound, etc., with junction boxes located at the principal street corners or points of union of the mains and feeders.

The overhead three-phase transmission system into suburban localities is erected on heavy poles on double petticoat deep groove glass insulators, with frequent transpositions in the line.

shown on this page. All lightning arresters are in the form of barbed wire conductors, erected directly over the three-phase conductors, and grounded at frequent intervals.

The two-phase distributing system is, in some localities, underground, has the converters located in large moisture-proof manholes and the secondary current distributed through regular Edison underground three-wire tubing. As this system is used to "pioneer" the three-wire direct current Edison low tension system, the change can be made easily by replacing the converters with direct current feeders laid to the main direct current distributing points. This is the only change necessary, since the house wiring, service connections, meters, etc., are similar in both systems.

The two-phase high tension distributing system, when erected overhead, consists of four primary conductors (2,400-volt) placed on the top cross-arm, and directly below are run the three heavy conductors of the secondary system. Between these two lines, at necessary intervals, are connected in the two-phase transformers, thus making a continuous secondary system with transformers, fed in multiple, at different points.



STREET LIGHTING SYSTEM.

The Brooklyn Edison Company operates about 700 low tension enclosed arc lamps for street lighting. These lamps are mounted upon ornamental iron posts, one of which is illustrated on this page, and connected with the underground Edison three-wire system. To facilitate the trimming of the lamps a reel and flexible cable is used whereby they can be lowered to the street level.

Inserted in the circuit of each lamp, and in the base of the post, is an automatic clock switch. The switches which are now being installed are of the self-winding, self-setting type, furnished by the General Incandescent Arc Lighting Co., of New York. The winding is done periodically by current taken from the mains, and the setting of the time switch to correspond with the different periods of turning on and off the lamps during the year is automatically accomplished by means of a cam, shaped to conform to the city lighting schedule. Thus each lamp is continuously, automatically lighted and extinguished to correspond with the city lighting schedule, the only attention required being trimming.

High tension series lighting is furnished in outlying portions of the city, there being now 1,750 high tension street lamps of 1,200 c. p. in use. The lamps are of the open arc type, mounted on ornamental standard or adjustable mast arms on a neatly painted wooden pole, as shown on page 25. The Company has now upon its circuits, including all systems, commercial and city, 6,317 arc lamps. The lamps in use comprise the 1,200 c. p. low tension open arc, 1,200 c. p. low tension enclosed arc, 600 c. p. low tension open arc, 1,200 c. p. alternating (60-cycle) open arc, 1,200 c. p. alternating (60-cycle) enclosed arc and the 1,200 c. p. high tension series arc.

LOAD DIAGRAMS.

All the energy of the company is now generated at three stations, the two stations which were former steam plants of the company, and located in the city proper, now operating only eight hours a day. By means of the Union Station and the two steam stations, operating eight hours a day, the load diagram "A," on page 21, which shows the distributed

energy used during a holiday, takes the form shown in diagram "B," which shows the corresponding current generated and equalized by means of storage batteries.

Diagram "C" shows the distributed load of an average day and diagram "D" this same load as generated and equalized by battery plant.

The two load diagrams, "A" and "C," show the system under the worst and best conditions, 250 of the days of the year having diagrams similar to diagram "C," and the remainder of the year similar to that of diagram "A."

THE LIGHTING AND POWER WORK OF THE COMPANY.

It goes without saying that the uses to which the current is put in various situations now reach into the hundreds.

In the field of incandescent lighting, stores, offices, theatres and factories, as well as private dwellings, have constantly taxed the company's current generating resources. Now that the new Union Station, with its high tension current, permits of sub-stations being planted in the midst of residential districts without in any way spoiling the appearance of the neighborhood, or making their presence objectionable to adjoining tenants, a large increase in residence lighting may be looked for. That the company is alive to its opportunities is patent by the erection of the Carroll street sub-station, which will,

LOW TENSION DOUBLE ARC LAMP POST.

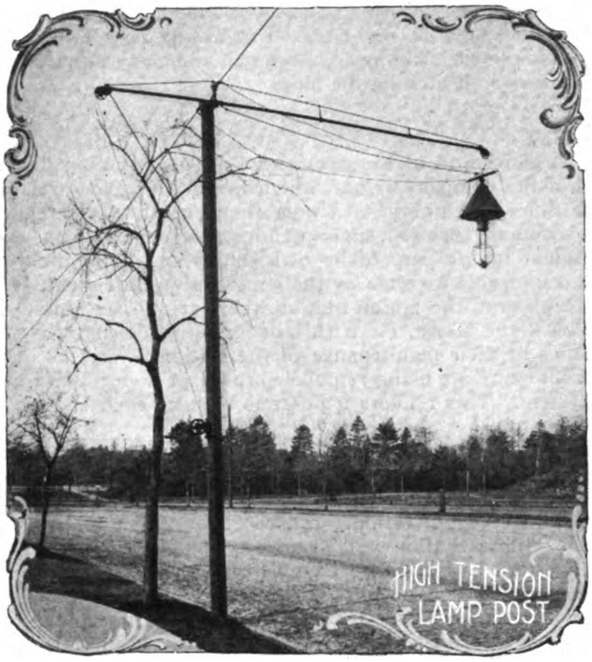
without doubt, soon find itself fully taxed by the demands of residents of the Park Slope.

As briefly referred to in the introductory, the Brooklyn Edison Company was the pioneer in the introduction of the low tension arc lamp and the thousands of them now burning nightly on their circuits, both as commercial and as street lights, testify to the long-headedness of those who introduced them. We might mention here that the company is now extending its circuits into Greenwood Cemetery, where it is making connection to the elaborate heating and lighting installation in the Mackey Memorial Tomb.

As to motors, the company, until the inauguration of the Union Station, has long been at its wits' end to supply the demand, both permanent and temporary. Only recently, for example, it was called on to furnish 100 h. p. to a factory, within twenty-four hours after the receipt of the order. It required considerable nerve to accept the order, but at the time specified the wheels were moving. Of course such "rush" orders are not the rule, but their successful carrying out shows what can be done when the emergency arises.

The uses to which direct current motors are now put on the Brooklyn Edison Co.'s circuits cover almost the entire range of the trades, from the running of ice cream freezers to that of printing presses, and taking power varying in amounts from ¼ h. p. up to 250 h. p. and more.

Not a little of the company's 2-phase system is utilized in



HIGH TENSION LAMP POST

driving electric motors, which are rapidly multiplying as their merits and economy become better known. As an example of this class of work we might mention the electric elevator in the St. Mary's Hospital, Brooklyn, which is running on the company's two-phase alternating system, and is one of many built by Mr. A. B. See, and installed in various buildings, hotels and private residences. These machines, one of which is illustrated on page 22, run with excellent uniformity of speed, stopping and starting nicely and require practically no care. Where it is desired to avoid the expense of an elevator attendant, the leading elevator manufacturing companies have devised a system by which, on touching a button the elevator ascends to the desired floor and stops there. The ability to run motors

HYDE & BEHMANS' THEATRE.

from multiphase alternating circuits greatly increases the scope of this method of distribution.

As to elevators run from direct current circuits they are numbered by the score. Perhaps as good an example as any is that to be found in the Edison Co.'s Pearl street station, which takes the visitor from the ground floor to the executive offices of the company. This elevator operates on the Leonard system.

Another very interesting elevator installation is that in the

Municipal Building, where an Otis electric motor drives a Quimby screw pump that forces the water to a tank on the roof, that gives the desired pressure for the hydraulic elevators.

It seems scarcely necessary to mention the work of the current driving thousands of small fans all over the company's territory. The extent of this territory, by the way, is well shown in the map of the new Borough of Brooklyn, on the supplement accompanying this issue, in which the company's circuits are indicated in red lines. Extensions now under way and contemplated in the near future will add many more streets to those now indicated on the map.

STATION MANAGEMENT, METER CHARGING, ETC.

The organization of the operating and construction departments of the company is one which brings into close relation all the different employés. Under the general superintendent of the company are ten superintendents of departments, each department taking care of its own duties and being held directly responsible for such by the general superintendent. With the exception of the Union Station, there are no station superintendents, the steam, electrical and building departments cooperating in their maintenance of the stations. The accounts of the company are being remodeled to adapt themselves to the new system. This renders it possible to keep each station account separate.

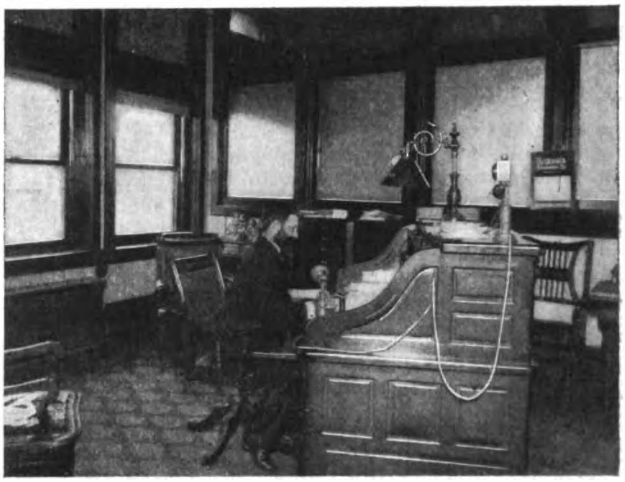
With the present 20,000 h. p. Union Station behind it, with a capacity for readily increasing to 60,000 h. p., there is evidently nothing to prevent the company from reaching out for business in every direction. Indeed it is not at all unlikely that the Union Station will eventually supply current to the entire western half of Long Island from north to south shore.

The company is now in a position to extend its system to the neighboring towns on Long Island, utilizing 12,000-volt. three-phase transmission. Work has already been started on one 12-mile line (three miles being submarine cable) which will transmit by May 1 of this year not less than 800 h. p. at a pressure of 6,000 volts. This current at its distributing point will be transformed by the local company into single-phase alternating, 60-cycle, high tension direct current for series arc lighting, the distance from the Union Station to the furthest series lamp being 15 miles.

METER ROOM, FIRST DISTRICT STATION.

All three-phase energy entering a sub-station is measured by wattmeter before it is distributed to the various transformer devices; all energy leaving a sub-station in any form whatever is measured by wattmeter, as is also all energy used in a sub-station for lighting, heating, etc.; all energy generated and used at, as well as that leaving the Union Station, is metered, so that a complete wattmeter record of the entire system is obtained. It was not thought necessary, on account of expense, to separately meter the energy entering the various transforming devices, as tests at frequent intervals will satisfactorily determine, mechanically and electrically, the efficiency.

All business done by the company is directly on a meter basis, the Edison electrolytic and Thomson mechanical meters being used exclusively. The Brooklyn Edison Co. was the first in this country to give discounts to any extent to customers for long hours of burning. Recognizing, however, that the business of the company should be the supplying of electrical energy pure and simple, independent of the purposes for which it is used, the company contemplates making such a departure



OFFICE OF MR. ROYAL C. PEABODY.
(Secretary and Treasurer.)

in its method of charging for current as will further reduce the price of current.

It has been the practice of the company to renew, at regular intervals, incandescent lamps installed among its customers. All incandescent lamps are renewed at stated intervals and replaced lamps returned to the lamp testing room, retested, returned to the store room and reissued or destroyed, depending upon the reading of the photometer, etc.

The work of the Brooklyn Edison Co. has been remarkable not only on account of its complete execution in such a short time, but also on account of the fact that all the work on the entire system, from the architectural designing of the building to the arrangement of the various mechanical and electrical devices, was conceived, designed and supervised by the company's regular operating departments. When it is realized that not less than 300 complete drawings were made and carried to execution by only four departments in less than eight months, and that, too, in addition to the regular operating duties of those departments, the extent of that work can be appreciated.

The new three-phase system of the Brooklyn Edison Co., its great Union plant and its numerous sub-stations, mark a great forward stride in the cheap generation and distribution of electrical energy. With such a system as is now begun the cost of energy will be reduced to a fraction of its former cost, enabling lower rates to be made for current, and thereby extending its field of use. With cheap coal and devices for using it, with private docks and the most economical coal handling machines, with the highest types of engines, generators, distributing and transforming devices, with the possibility of producing electrical energy on such a large scale with an attendance of six men, who can conceive of a more perfect or economical system? The system is, indeed, a monument to the genius of Edison and Tesla.

THE COMPANY'S OFFICERS.—CONCLUSION.

We might go on indefinitely dealing with the innumerable details which go to make up the sum of the business of a company such as that under consideration; but that would lead us too far. Enough has been said and shown, however, to indicate the vast extent of the ramifications and the utility of such an organization, which comes in daily touch with thousands of citizens, many of whose work and welfare depend upon the conscientious fulfillment of the company's obligations. It is this latter feature which, perhaps as much as any other, has given the Brooklyn Edison Co. such a firm hold on public confidence,—that powerful lever for the lack of which no other merits, however great, can make up.

That the work of the company is entrusted to good hands a glance at the names of its officers will make evident. These

are: President, Ethan Allen Doty; vice-president, Edwin Packard; secretary and treasurer, Royal C. Peabody. Board of Directors: Frank L. Babbott, E. Le Grand Beers, Chas. E. Crowell, Julian T. Fairchild, C. N. Hoagland, Darwin R. James, J. G. Jenkins, Martin Joost, Lowell M. Palmer, George Foster Peabody and George H. Southard. Counsel, Frank Harvey Field. Throughout the entire history of the company, from the day of its first inception to the present time, no one has done more to make it a financial success than its secretary and treasurer, Mr. Royal C. Peabody.

Where so much depends upon individual effort and intelligence as is the case in the technical operation of a great current distributing system, it seems almost invidious to single out for special mention any particular individual; but we feel certain that no one in any way connected with the Brooklyn Edison Co. will take umbrage at the mention of the name of the general superintendent, Mr. W. S. Barstow. Risen from the ranks, Mr. Barstow has by his untiring energy, technical ability and rare good judgment gained the fullest confidence of the management of the company, a confidence, by the way, expressed in a most substantial manner on more than one occasion. But more than that, Mr. Barstow has gained the respect and absolute loyalty of all who have the good fortune to labor under his guidance. And in closing we must also tender to Mr. Barstow our most sincere thanks for the great aid extended to us in the preparation of this article.

Public Control, Ownership or Operation of Municipal Franchises?—I.

With Special References to Electric Lighting.*

By R. R. BOWKER,

(Vice-President and General Manager New York Edison Co.)

A MODERN municipality is at once a small state or body politic, and a great corporation or co-operative business. In emphasizing its functions as a business, its limitations as a government must be not less emphasized. If that government is best which governs least, the public should not undertake what private enterprise can do as well. The "government of the people, by the people and for the people" of Lincoln, truest of Democrats, meant a Democratic republic, not a Populistic Socialism. If the trend of the municipalization of industries makes toward Socialism in the State, there is reason for caution.

It is recognized by most thinkers that the social increment belongs to the people. The public, and not private interests, should benefit from the increased values directly caused by the growth of a great city. This does not involve Socialism or the municipalization of industries. It does demand that franchises should not go out of the people's hands without limits as to time, safeguards as to price and adequate power of control.

DEVELOPMENT OF MUNICIPAL INDUSTRIES.

The private or toll road, the well or spring, the private cistern, the tallow dip or oil lamp develop in a modern city into great public needs which can be handled only in an organized way. Among the facilities answering to such needs are streets, sewers, the supply of pure water for drinking and for steam, and of salt or other water for flushing and for fire use, lighting by gas or electricity, telegraph and telephone communication, the supply of power through conduits, street transportation—surface, elevated or underground—pneumatic tubes and postal, messenger or parcels service.

Good roads, it is conceded, must be provided by the commonwealth, as also sewerage; water supply is usually, though not always, considered a municipal function; lighting, communication and transportation are on debatable ground; there are few in this country who approve public bakeries or storehouses, although bread is a necessity of life. Somewhere within this range is the point where Democracy becomes Socialism. It is important to limit the function of the municipality at that point, and not to be misled by the phrase that "a city is a business corporation."

There is no longer any question of the legal right of a municipality in these days to enter almost any field of public supply. Practice has made abundant precedent, and repeated decisions of the courts, culminating in the Rapid Transit decision of the New York Court of Appeals, has settled beyond doubt the legal right of municipalities to invest in and operate what may be called municipal industries. Indeed, so far has practice gone, as in actual cases where electric lighting has been supplied to private consumers below cost at the expense of taxpayers in general, that it is difficult to apply the limiting decision of the United States Supreme Court in the Topeka case that "there can be no lawful tax which is not laid for public purposes." The real limits of municipal activity must be found in an alert and wholesome public opinion which will prevent steps that lead by easy reaches into Socialistic enterprises, pure and simple.

NATURE OF MUNICIPAL FRANCHISES.

A municipal franchise is generally understood to mean a freedom or privilege granted by a municipality giving to companies or other private persons the use of public property or facilities, as of the streets, for the supply of conveniences or commodities to its citizens. The phrase has come to mean indeed an industry for which a franchise would be needed, and has been applied even when such an industry is operated by the municipality. Too often a franchise has been a free gift to private persons; but it is now conceded that such privileges should involve adequate return to the public. This may be made either by reduction in price, giving advantages directly to those citizens who are consumers, or through payment to the municipality of taxes, license fees, royalties on output or gross returns, or share of surplus profits, which last is perhaps the best way because it does not increase or tend to keep up price, but does offer to a supply company an inducement both to enterprise and economy. It does not matter to a gas supply company, for instance, whether the price to consumers is $1.25, out of which 25 cents is paid to the city, or is $1 to consumers direct. On the contrary, it does matter to taxpayers, when a municipal corporation operates an industry, whether the price to consumers is made at or below cost. While in case of profit the citizens generally reap the benefit through the municipality, in the case of loss they have to pay their quota, through taxes, for the benefit of those citizens who as consumers have had their supply at less than cost. In private companies this result of miscalculation or bad management falls only on those who as shareholders have deliberately taken risk.

Franchises to supply public needs are often generalized as monopolies, but a distinction should be drawn. The postal service of the government is a monopoly and an artificial monopoly, because the law makes competition a penal offence. At the start the well and the private cistern may exist alongside the general water supply and sewerage system, but, as a town grows into a city the Board of Health must intervene, and water and sewerage become practically monopolies. Railroads, telegraph and telephone lines are not in themselves monopolies (except as the telephone system is founded on exclusive patents), for it is chiefly because of the public value of an extended and centralized system that new or lesser competitors

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the business cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

have little chance. Lighting is not a monopoly because gas and electricity have oil, as well as each other, for competitors; and an electric company must also compete with private electric plants—which prevents extortionate prices by what economists call substitution use. It is only when the use of the streets is given to one company or private person as against all others, that there exists a real monopoly in such service.

DISTINCTIONS AMONG INDUSTRIES.

The real key to what is usually called a municipal industry is in this fact: As the whole arterial system of the human body radiates from one central supply station, the heart, so the supply of water, gas, electricity, telephone communication, etc., in a great city, to be constructed and operated at best advantage and at least cost, must radiate from one or more central sources of supply, using the streets as arteries. Here competition involves duplication of investment, increased waste, multiplication of operating expenses, in short, economic loss instead of gain. A unified street railway system with its advantages of transfer has the same economic advantage over independent lines. The inevitable trend in all these cases is, therefore, toward consolidation instead of competition. It is often cheaper to throw parallel systems out of use than to continue the waste of double operating. Competition, in such cases, does not act to reduce price, except by the cut-throat competition of rate-cutting, which involves a final loss instead of a public gain. If three gas mains exist where but one is needed, there is three times the investment cost and three times the operating expenses; costs, and therefore prices, are higher; and in the end, usually one system survives, and the other two are dead loss. The limitation of price, therefore, must be brought about, in private operation, not from competition but by the application of sound business principles on the part of those controlling the industries or by the exercise of the power of municipal regulation in connection with the use of the public streets.

A distinction is to be made between the distribution of natural products and the manufacture of artificial products. Water supply is the distribution of a natural product. There is no manufacture, unless pumping and filtration be so considered. The production of gas or electricity is, on the contrary, a most complicated process of manufacture, especially requiring skilled labor and directive ability. Co-operative production has failed more than once where co-operative distribution has succeeded; and here, perhaps, should be one line of division between municipal and private enterprise.

Another distinction is to be drawn between free and commercial service. The streets are free. Sewerage is free. Water supply is partly free and partly paid for in water "rates" or taxes, especially by large consumers, directly according to metered consumption. Street lighting is free, commercial lighting is individually paid for; but each costs less to produce or distribute when combined with the other. Possibly the line of municipalization should be drawn at supplies which are wholly or chiefly free.

A line is sometimes drawn at necessaries of life. Air is a first necessary of life, and the limitation by law of the height of buildings may be required to prevent dangerous fouling of air in the streets and lower stories. Water is a necessary of life and is supplied usually, though not always, by the municipality. Food is always a necessary of life, heat and clothing are necessaries in most climates; nevertheless, these are not considered, except by extreme Socialists, as properly included under municipal functions. Lighting is a convenience, almost, but not quite, a necessary of life. Transportation is a convenience, but scarcely a necessity. It does not seem that this line of division has real bearing.

Clear thinking is most necessary in distinguishing between public control, public ownership and public operation. Public control involves inspection and regulation, but not necessarily ownership or operation. Public ownership may involve the ownership of the distributing system only, for which the public highways must be used, or of the manufacturing plant also—a distinction most important, though seldom emphasized. Public operation means the actual administration, as a productive business, of both manufacture and distribution. It is important to keep these distinctions in mind in considering the status in respect to public service in the great cities of the world.

City Lighting at Atlanta, Ga.

Mr. H. M. Atkinson, president of the Georgia Electric Light Co., of Atlanta, Ga., discussing the present agitation in that city for a municipal plant says:

"We have been making electric lights in the city of Atlanta for seven years and have been studying the question carefully. I have read everything that has been written that I could run across and I have no hesitation in making the broad statement that there is not an electric lighting plant owned by a city in the United States to-day that is furnishing, under similar conditions, anything like as good service for the money that Atlanta is paying.

"I will further state that there is not a single instance in this country, where a city is lighted by its own plant, in which private enterprise would not furnish as good service under similar conditions for 20 per cent. less than it is costing.

"An investigation of the facts will show beyond doubt that the ownership of electric lighting plants by cities in this country is a record of unbroken failure to achieve the results claimed by the advocates of the policy.

"Now, the whole burden of proof is upon the advocates of municipal ownership to show irrefutably that the taxpayers can save money by adopting such a policy."

TELEPHONY AND TELEGRAPHY

Telephone Employees' Dividend in Cincinnati.

Captain George N. Stone, of the Cincinnati Bell Telephone Co., gave the employés of that organization a great surprise. Formerly the Christmas gift of the company has been a gold piece. This year each employé received a dividend upon his salary, as is stated in the following notice printed on the envelope containing the money:

"Employés' Dividend.—By order of the Board of Directors, you are entitled to a dividend, payable from the net earnings of this company, equal to 8 per cent., computed on your salary for the year ending December 31, 1897, for efficient services rendered the City and Suburban Telegraph Association.

"G. N. STONE,
"General Manager."

For example, the young ladies' salaries range from $27 to $50 a month. The company's Christmas gifts, therefore, range from $25.92 to $48 to each employé.

New Telegraph Facilities in Mexico.

The Mexican Telegraph and Cable Company and the Western Union Company have secured a concession from the Mexican government to connect their wires in the United States with the Federal lines at Nogales, Juarez, and Laredo. Through dispatches can thus be sent by government wires to the United States and all points abroad. Official messages to or from the Mexican ministers and consuls in the United States will be transmitted at 50 per cent. discount from the tariff.

The Western Union will pay 15 per cent. of its receipts to the government for the franchise and guarantees that this payment shall be not less than $20,000 gold semi-annually. The cable company also pays the same percentage, guaranteeing at least $10,000 gold semi-annually. The Central and South American Cable is not included in this. The government agrees to send all its foreign dispatches by these two lines.

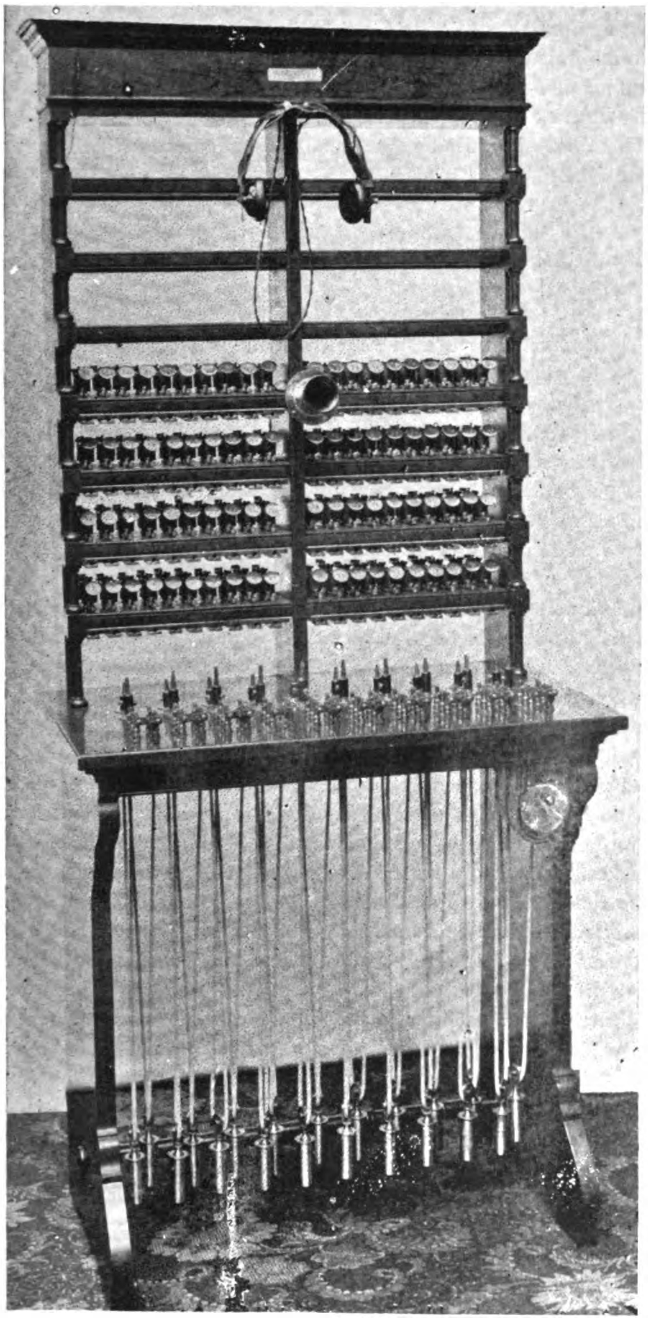
Long Distance Telephony and the Railroads.

S. R. Callaway, president of the Lake Shore & Michigan Southern Railroad Company, says: "For some time railroad men have been trying to find the reason why, in spite of the fact that business is increasing, especially in the transportation of freight the passenger business is languishing.

"After figuring on the matter we have come to the conclusion that the long distance telephone is responsible. Business men are using it more and more and the way it is cutting into our passenger business is a very serious matter to us."

New Switchboard of the Central Telephone and Electric Co., St. Louis.

THE Central Telephone and Electric Co., of St. Louis, Mo., have just perfected a new type of telephone switchboard, claimed by the manufacturers to be the most easily operated of any on the market and also possessing the great advantage of being built on an increase plan, whereby the purchaser may select a cabinet of sufficient capacity to accommodate as many drops as he may consider will possibly be needed and have installed only the number of drops actually needed to start with.



NEW TYPE OF SWITCHBOARD MADE BY CENTRAL TEL. & ELEC. CO., ST. LOUIS.

The drops and spring-jacks are placed on each shelf and the purchaser has as many shelves filled as desired. When increase is in order, he need only send vacant shelves (which are detachable) to the factory and have them filled. After being filled they can be placed in the cabinet by even the most inexperienced person.

Each drop is composed of two coils wound to resistances which equalize the drawing power of both magnets. This is especially desirable where long lines are connected to the switchboard, as it requires but little current to create magnetism in these drops. With the drawing of both magnets, an indicator may be dropped when a call is made over much longer lines than can be successfully attached to the ordinary boards.

All drops are so placed that when the indicators are raised no part of the drops project in front of the spring-jacks. Hence an operator cannot by any accident drop an indicator while connecting cords.

Each spring-jack is directly beneath the indicator of the drop to which it is connected, so that the operator has only to look when a call is made and can plug in and raise the indicator with one hand at the same time.

One of the greatest advantages possessed by this switchboard is in the plug conections. Each set of plugs is composed of a long and a short plug. The short plug is inserted in the spring-jack of the line calling, which connects the subscriber direct to the operator's transmitter and receiver. Gravity batteries are used for the transmitter and therefore no receiver switch hook is necessary to open or close the battery circuit. When the operator is informed of the line wanted, she lets the short plug remain in the spring-jack of subscriber calling and takes the long plug of the same set and inserts it in the spring-jack of the line wanted. This plug automatically cuts out the drop and connects the generator direct to the line, thus leaving absolutely no resistance in the switchboard for the generator current to overcome. On this account calls from switchboard may be made over even longer lines than the same generator would ring over if connected in magneto bell on a telephone.

As soon as the subscriber wanted has been called, the operator throws the knife-switch in front of the plugs to the opposite side, and both cords are then in the same circuit and all parts of the switchboard are cut out, with the exception of one drop, which remains in circuit for the purpose of notifying the operator when the conversation is finished. Any short plug may be used for a listening plug if desired.

The entire space occupied by 100 drops and spring is only 20 inches by 24 inches and a board of 200 drops may be so arranged that one operator could reach each drop and spring-jack without leaving her chair. Each drop is distinct and separate from any other drop and as the line wire is connected to the binding post in the rear of each drop, there is no mass of wires connecting various parts of the switchboard.

The cabinets for switchboards are made from seasoned cherry wood, which is highly polished and very elegant in appearance. Each cabinet is furnished with a "Perfection" long distance granular carbon transmitter, mounted in a short nickel-plated adjustable arm, which is attached to the cabinet directly in front of the spot where the operator will sit. Each switchboard is also furnished with either head or hand receiver as desired, a 25,000-ohm generator, a night alarm with switch, a guaranteed lightning arrester, and batteries for operating both transmitter and the night alarm.

The Central Telephone and Electric Co. have just issued a new catalogue of everything needed in telephone business, which also gives a great deal of useful information to any one interested in telephones. A copy of this catalogue will be mailed to any address upon application.

The Hummel Facsimile Telegraph.

According to the New York Herald a trial was made in its office last week over eight miles of wire of the Hummel facsimile telegraph, of which notices have appeared in the newspapers. Mr. E. A. Hummel, who is a jeweler at St. Paul, Minn,. was present and conducted the trial himself. The Herald vouches for the success of the experiment, and says that in 22 minutes Mr. Hummel transmitted over the eight miles of circuit a portrait of Mayor Van Wyck, which it reproduces in its issue of January 2. According to the Herald, one of the long-cherished dreams of the century is now fully and satisfactorily solved. There is nothing like solving a dream, so the New Year opens well, and we extend our congratulations to Mr. Hummel. All that his invention now needs is a real test as to originality and availability.

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The Failure of State Ownership of Canals.

JUST at a time when the proposition to have the State undertake a lot of new duties and administer several different kinds of property or industries never before entrusted to it, comes the news of the utter failure of the State of New York to maintain its canals in a fit and proper condition. This year, when the grain-carrying trade has reached tremendous figures, the Erie Canal has fallen off seriously, we believe, in its tonnage, and the boatmen are universally complaining of the fact. Yet at such a time, when the canal is earning least, but should be earning most, the discovery is made that vast expenditures are necessary to preserve the big ditch from utter disintegration. Nor is New York State alone in this embarrassment, for we mentioned last week the like difficulties now to be confronted in the State of Ohio, where the canals are also in the hands of the State government.

Years ago, when the States went in heavily for canalization, the picture of prosperity and profit was a glowing one, and the money to be saved or made by the public purse was counted by the tens of millions. It is exactly the same way to-day in the minds of the advocates of government control of railways and telegraphs or municipal ownership of lighting and street railway plants. But the real facts, the solid facts of years of operation, all point the other way. The State spent $7,500,000 on the Erie Canal to begin with, and has had to go on spending money on all its canals, while the expenditure on the Erie alone, up to the recent work, had reached $50,000,000. These startling figures are not such as to surprise those who know that the 4,500 miles of canal in this country, costing $214,000,000, are nearly all in as bad shape. The abandoned canals are 1,953 miles, if not more, and a very large proportion of the 2,500 miles remaining do not pay expenses.

But, returning to the New York State canals, it may be noted that in 1895 the people voted a bond issue of $9,000,000 to increase the average depth of the canals from seven feet to nine feet. It is now stated that to finish the work and render effective the $9,000,000 another $7,000,000 will be necessary. The facts in the case are said to have been known for some time past, but they have only now leaked out, and great is the public agitation. Moreover, the allegation is made that despite all the expenditures, the canal system of the State is in a terrible condition of decrepitude and ruin, so that many further millions may be required to make the canals play that part in the State's internal economy and commercial supremacy which has been the aim from first to last.

We have no wish to enlarge on this state of affairs, no wish to suggest wrong doing in office. Our own belief is that the immemorial proof of the inability of any State or municipality to administer economically or in an up-to-date manner is quite sufficient to account for the breakdown of the canal system in New York and the fabulous cost of insufficient maintenance. The State should lease the canals or fill them up and pocket the loss.

The Brooklyn Edison Solution of a Great Problem.

IF the electrical historian of the future in surveying the field of electrical work in America from 1885 to the end of 1897 should wish to single out any departures in central station and current distribution practice, he would be obliged to confine himself to the consideration of a number of details of more or less importance, but he would find it difficult to cite an example of what might be termed a distinct new departure. It would be unfair to deny that substantial and valuable improvements had been made in numerous details, but from the time of the introduction of the alternating current at the first period above mentioned there has until recently been no distinguishing mark discernable in the general handling of current within cities. The alternating current deserves the credit of having widened immensely the field of electrical operation; one might go as far even as to maintain that without it the great industry as it stands to-day could claim but a fraction of the victory which it has gained in so short a time. Yet on the other hand it would be rash to assert that the direct current had not more than held its ground in the fierce competition. We make this assertion with due regard to all the circumstances in the case, and more particularly to the present position of the direct current as a means of distribution, as distinguished from transmission. And the factor which has perhaps more than any other aided to bring about this result is the electric motor.

But without seeking further for causes, it must be recognized by many that the days of rabid partisanship of the advocates of the alternating or the continuous current, respectively, are gone, never to return. Practical experience in distribution work, combined with the new types of machinery offered by the manufacturers have gradually led to a modification of the older ideas, and we think it may now be safely asserted that the furnishing of current for extended city areas will be carried out by a combination of the alternating and the direct current—the alternating for transmission to local centers and the direct current for low tension house-to-house distribution.

The credit of pioneering this movement in actual practice is due to the Brooklyn Edison Illuminating Co., whose latest work in this direction is described in this issue. This work marks an epoch in electrical engineering and distribution work in America, and as such we have deemed it worthy of the generous space and elaborate description devoted to it. We feel certain that every central station company having in mind extension of its work, or contemplating reconstruction or proposing the erection of a new station will find it advantageous to study the work now being carried out in Brooklyn. Considering the problem there involved, it seems difficult to con-

ceive of any arrangement or system better adapted to the conditions than that thought out and carried out by Mr. Barstow.

As to the design of the new Union Station, it would be pretty hard to beat that so far as simplicity is concerned,—and simplicity has always been synonymous with efficiency in mechanical and electrical work. The adoption of the three-phase current for transmission purposes will also, we believe, meet with the sanction of those engineers best able to express an opinion in such matters. We cannot too strongly express our gratification, also, at the fact that the entire high tension system of conductors within the populated sections of the city has been placed underground. As to the actual results obtained, the short time during which the new Union Station has been in operation has already demonstrated the wisdom of the step and has placed the Brooklyn Edison Company in a position to carry on its work with facilities second to those of no other electric current distributing company in the world.

We cannot permit this occasion to pass, also, without extending our congratulations to all those whose apparatus, both electrical and mechanical, has made it possible to carry out this truly great work. It speaks volumes indeed for the potential abilities of our electrical and mechanical manufacturing industries, which enable them to meet, on demand, a call for such apparatus as is embodied in the new work of the Brooklyn Edison Co., to whom we also venture to extend our congratulations on the bright future before it, and the courage with which it has pointed out a solution of the great public-service problem—how best to furnish current for all uses over a large city area.

The Possibilities and Limitations of Electric Traction.

UNDER the above title Mr. F. J. Sprague discourses on a favorite topic of his in the January number of the Engineering Magazine, setting forth again, in the light of fuller experience, his opinions as to the field open to electricity in railway work and that closed to it, at least for the present. Mr. Sprague divides transportation lines into six different classes, beginning with street car or surface, city and town lines at one end, and ending with the independent steam lines and inter-connecting systems, the last two handling both freight and passenger service. These various systems are apparently radically different, and the reasons which might make the adoption of electricity advisable in one case would make it prohibitory in another. It goes without saying that some sort of electric traction system on street car lines is considered by Mr. Sprague advisable beyond argument. So also does he consider that method of propulsion the only one for tunnel and elevated railroad work, examples of which are now rapidly multiplying—excepting, of course, the New York elevated system, whose "lamentable inertia" Mr. Sprague deplores. As to the method of operation of such roads, Mr. Sprague shows that as far back as 1887, before the days of Richmond, he advocated the distribution of the motive power to the individual cars constituting a train, so that they can be operated in any combination and from any point of a train. The acceptance by the South Side Elevated Railway of Chicago of his new individual unit system after official test, and his own experience, warrant Mr. Sprague in predicting for this system, radical departure as it is, a future as important as that marked by the advent of the trolley. It suggests to him the further prediction that Chicago will be the Richmond of the new development. Mr. Sprague has been a pretty good prophet in the past, and if he will stand behind his new system in the same way as he did behind the trolley at Richmond, we would not care to give odds to the scoffers. In closing his article, Mr. Sprague tells us that he did not fully realize all the possible results of his multiple unit control system until he had become familiar with a remarkable series of investigations, embracing all the conditions of railway practice, made by Mr. John Lundie, consulting engineer of the Illinois Central Railroad, when considering the possibility of applying electricity to that road's suburban service. The question of acceleration is here paramount, amounting to 40 miles in 20 seconds for an 80-ton train. From a hint thrown out by Mr. Sprague it would seem that the Illinois Central operations will merit the careful attention of both steam and electrical engineers and railway managers. For all the conditions met in suburban work, the multiple unit system of control appears to Mr. Sprague indispensable and he considers the displacement of the steam locomotive, in fact of all locomotives, assured. The consideration of electric trunk railway service Mr. Sprague reserves for subsequent discussion.

Long Telegraph Circuits.

THE improvement even in an elder electrical industry like the telegraph is steady and unremittent. Last year at this time, note was made in our pages of many of the advances in the art. One of the most appreciable gains is in the length of the circuits over which messages are sent unrelayed. The Western Union Telegraph Co., for example, has often worked direct for regular business from New York to San Francisco, 3,300 miles. But we now learn from Mr. A. S. Brown, electrical engineer of the company, that on December 28 they worked direct from New York to Mexico City, a distance of 3,490 miles, and thought nothing of it. Only old telegraphers can fully appreciate all the gains that this simple statement of bare facts carries with it.

This Issue of The Electrical Engineer.

WE may be pardoned for venturing to emphasize the signs of industrial and commercial recovery afforded by the current issue of The Electrical Engineer, with which the New Year is begun auspiciously. In sheer bulk and volume, this number far exceeds any issue previously sent out of The Engineer; and it is probably the largest, most solid issue of an electrical journal ever actually made in this country. Mere size, however, is no criterion, and it is hoped that the contents in scope and value are also worthy the occasion. Of this our readers will judge for themselves, as usual, for if there is any one thing distasteful to self-respecting journals it is to vaunt their own merits. An endeavor has been made, it may, however, be pointed out, to enhance the appearance of the reading pages by a change of typography. In order to give the utmost quantity of reading The Engineer is often printed almost entirely without "leads," and a more open type has therefore been selected, which makes the page more legible, without lessening the amount of matter.

Electric Rapid Transit in New York.

MAYOR VAN WYCK, of the Greater New York, in his initial message to the Municipal Assembly, comes out pretty flatly against underground rapid transit, on the ground that "Reform" and the recent consolidation have overrun the constitutional limit of debt. Something of this kind was to be expected, although the apparent desire of the Metropolitan Traction Co. to carry out the underground plan may serve to redress the balance. When Tammany says the city is running into debt too quickly it must needs be believed, for if there is one thing Tammany abhors it is civic debt and official extravagance. We are glad to note at the same time that Mayor Van Wyck urges on the Elevated Railroad better facilities, including the abolition of coal burning engines and the adoption of electricity. He is right, and of course the change will now come more immediately than last week. We are also glad to note his recommendation that all the surface roads adopt the "most approved motive power." People who say that this remark means compressed air may be observed to wink one eyelid. Of course what the Mayor refers to is electricity.

ELECTRIC TRANSPORTATION

Mr. A. L. Riker's New Electric Victoria.

WE illustrate herewith the very handsome electric vehicle recently built by the Riker Electric Motor Co., for a resident of New York. It carries two passengers, has a child's seat besides, and weighs all told 1,700 pounds. The frame is of 1½-inch steel tubing. The front wheels are 28 inches and the rear 32 inches, and Hartford pneumatic tires of 2½ inches diameter are employed. The usual pivotal steering already described in Mr. Riker's other carriages is used.

The Riker iron-clad motor, 1½ k. w., weighs 142 pounds and is geared to the axle by a spur gear nine to one.

The battery, composed of 40 Willard cells, which weighs 800 pounds, has a capacity of 100 ampere hours at a five-hour discharge rate, and can be recharged in three hours.

THE NEW RIKER ELECTRIC VICTORIA.

The vehicle is controlled from the seat, like the trap already described in our pages, except that the controller handle is between the two passengers and is operated by the right hand, while the bell is operated by a push button fixed in the end of the steering handle.

Mr. Riker reports that his victoria has been run 1,200 miles around New York City.

The Riker Co. are now building, on order, four traps, three doctor's buggies, two delivery wagons and a brougham and expect a large electric carriage development this year.

Electricity on the Brooklyn Bridge.

The Brooklyn Bridge trustees in their report just out say: "During the past year 45,542,627 passengers were carried over the railway, being a larger number than in any previous year of its operation. It has been in service a term of about 14 3-16 years; during this period 480,692,936 passengers have been carried. Referring to the two means of hauling trains on the Bridge, by electric motors for switching at the stations and by cable over the main tracks between the stations, it is often pertinently asked why the latter is not entirely replaced by the former, ready and capable for the service, as it has proven to be after continued and satisfactory trial.

"In reply it may be said that in a round trip over the railway —which is transit from one station to the other and back again —a train in surmounting the grades over the structure has to be lifted about 140 feeet; thus, if all the trains in service are attached to a running cable, it involves an expenditure of power but little exceeding that required to haul the same number of trains over a level track, the trains descending nearly or quite balancing those ascending. If electric motors were used for hauling the trains over the main lines, whatever power was expended in surmounting the grades could not in descending be returned or compensated for; as a result there would be a loss of power equivalent to that required in a round trip to lift each train vertically to the extreme height mentioned.

"Also, trains running attached to the cable are separated by fixed and uniform spaces as determined by the wisdom of the superintendent in charge; while, if trains were hauled by independent motors, this spacing would be subject to individual care and judgment. In the first case, collision between the trains running close to each other, as they must during the busy hours, is effectively guarded against; on the other hand, if the movement of each train was controlled solely by its motormen, collision between trains might be frequent and sometimes, perhaps, with appalling results."

NEWS AND NOTES

The Montauk Multiphase Cable—A New Interior Electric Cable.

IT is not often that we are enabled to chronicle a decided departure in the construction of electrical conductors, hence the rareness of such occasions makes an announcement of this kind specially noteworthy, more particularly when the new product is one of undoubted value viewed from both the commercial and the electrical standpoints.

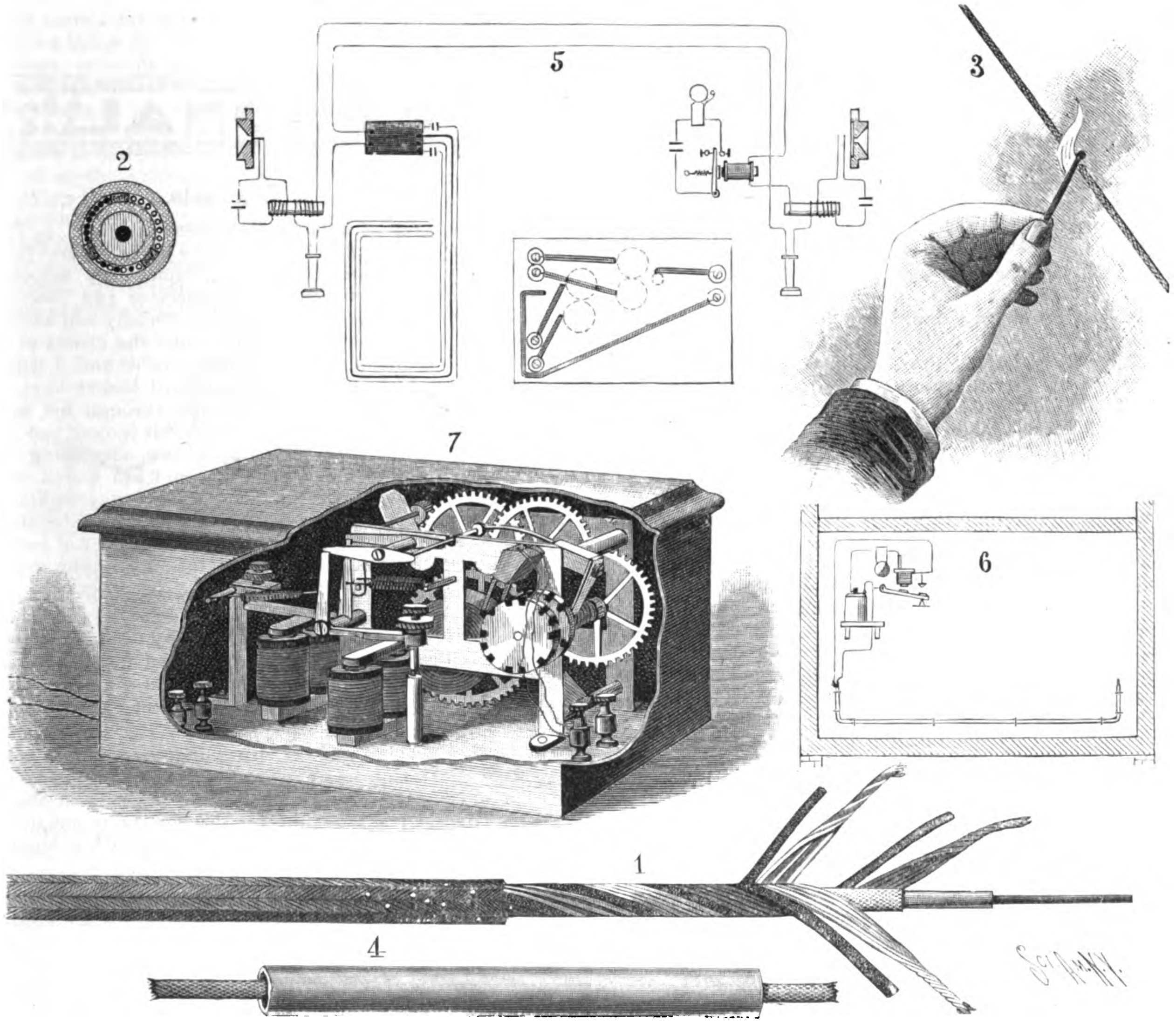
We refer to the new interior electric cables of the Montauk Multiphase Cable Co., of 100 Broadway, at whose offices we were recently afforded full opportunity for testing the merits of this decidedly ingenious product of the cable maker.

Before describing the cable itself we may premise that the salient feature in the construction of the Montauk "multiphase cable" consists in making every inch of the wire installed an infallible detecting point for the discovery of dangerous heat or flame, combined with the ability to give automatic notification of the same at any desired number of points, thus making the cable continuously thermostatic throughout its entire length.

Combined in the Montauk cable with this protection from loss by fire, are all of the necessary wires for giving every kind of electric service which is needed for all interior electrical installations, whether for electric light or power, fire or burglar alarm, etc.

It is not expected by the owners that this cable is going to do away with any present appliances, but it is believed not only by themselves, but by many of those who have investigated this system, that the additional protection that can be acquired through its use will be many times greater than the combined protection heretofore given. In other words, it is the additional protection which has been sought for by property owners and insurance companies for many years, but until the present time has remained undiscovered.

The construction of the cable is as follows: A solid copper conductor, Fig. 1, is surrounded by a fusible core which is in turn covered with proper insulating materials. On the outer side of the insulation a second, a third and fourth conductor are so placed as to be insulated from each other by like insulating material; all are then protected by a heavy outer covering or insulation such as the installing conditions may require.



THE MONTAUK MULTIPHASE CABLE SYSTEM.
(Showing Method of Operation and Connection with a Telephone Exchange, as Illustrative of Its Operation.)

The outer covering of the conductor, while being ornamental, waterproof or dampproof, is sufficiently strong to withstand considerable mechanical injury. If any part of the conductor is subjected to the flame of an ordinary match or dangerous heat for a few seconds, the fusible core melts and makes contact with the surrounding conductors; an alarm will thus be immediately sounded and by the use of an indicator the precise location of the fire is announced.

By a simple method of connection each station or room can be operated independently of every other station or room in a house or other building and the entire system or any part of it can be tested at any point desired without giving an alarm.

In order to establish the system it is only necessary to place a small battery and indicator in position, connecting the core

with one terminal of the battery and (if a twin conductor cable) the other or exterior conductor to the other battery terminal having the indicator wired in series with the same.

If a building is without a watchman, then the cable takes his place, and is far more efficient, because it would be simply futile to expect that a watchman can be wherever all the danger or fire lines are at the same moment, and yet this is the service performed by the cable, covering, as it does, all "danger lines" at once and at the same time.

In the above we have alluded only to the application of the Montauk multiphase cable as a thermostatic device. But it has other equally important applications. Thus it is specially adapted as a burglar alarm wire in addition to its thermostatic qualities. If, for example, a burglar attempts to cut the wire the very act of cutting short circuits the core and the surrounding conductors for an instant, which is quite sufficient to start the alarm ringing, or if the closed circuit system be employed, the severance of the cable conductors opens the circuit and similarly starts the alarm going.

In order to give the cable an extended sphere of usefulness, the company has devised an excellent system whereby the multiphase cable can be used in conjunction with alarms placed in telephone exchanges, district messenger or fire alarm stations, and without adding in any way to the number of wires now employed in these various services nor in any way interfering with them. This is accomplished by the employment of a controller, such as that illustrated in Fig. 7, shown in connection with a telephone exchange, Fig. 5. The controller is placed at the subscriber's station and is so constructed that it gives three distinct signals indicating "fire," "burglar," or "trouble."

We need hardly point out the additional value with which every telephone or district messenger company might endow its system by the addition of such a simple device in connection with the Montauk cable.

The company have standardized all conductors of this cable as follows: Nos. 12, 14, 16, 18, 20, 22, B. & S. gauge; other standards will be forthcoming as rapidly as conditions of manufacture will permit. These standards are those most used by the trade, and accord in size with those adopted by the chief electric interests now existing.

This cable is not intended to be in any way antagonistic to any vested interests, but auxiliary thereto, and while greatly increasing the volume of electrical work, is also intended to greatly increase the earning capacity of existing plants, without increase of operating or maintenance account; the only cost, in the first instance, being the primary installation by the electrical contractor.

In order that the contractor may estimate intelligently upon the "cabling" of buildings for fire, the company have compiled a "Contractor's Hand Book," based upon fire statistics for the past thirty years. This is so arranged that with it in hand, the contractor has but to refer to any particular classification, where he will find the various causes of fire under that head, and be able to "cableize" the particular installation he may be considering, understandingly. As there are 129 classifications it can readily be seen that a new and very large field for business is open to the electrical worker.

THE STOCK MARKET

The Old Year and the New.

It will be remembered that 1897 did not open very propitiously. It cannot be said that the close was particularly bright, coming, as it did, with a large bank failure in Philadelphia, the collapse of a big safe-making trust corporation, and the failure of one of the biggest bicycle builders. But there was a great brightening up of the prospects of business, a paying up of debts, and an accumulation of wealth largely from the sale of the crops; and the untoward events of December were not symptoms, but more in the nature of echoes of bygone troubles. That business will be better in the year 1898 seems beyond question; that there will be boom and rush is happily open to much doubt. People will be in easy circumstances, but they will not pull in money "hand over fist." The efflux of gold from the Klondike may, however, be large enough to make the times resemble those of previous great gold epochs in their buoyancy, especially if, as predicted, the metal comes out by the ton. Meantime the country has its coat off and is working hard, which is the best guarantee of prosperity that can be asked.

The stock market is waiting and watchful, chiefly concerned to see what Congress will do toward giving greater stability to the currency, combined with reasonable flexibility. During the last week of the year Western Union sold to the extent of 45,071 shares, up to 91¼. General Electric, on sales of 7,880 shares, was up to 34; American Bell Telephone, on small sales, went up to 267.

Copper is quoted at 10.87½ cents; heavy steel rail at $19.

PERSONAL

Mr. E. J. Wessels.

With much regret we note the retirement of Mr. E. J. Wessels from the managing directorship of the Standard Air Brake Co., after three years of active and conspicuously successful association with that concern. The readers of The Electrical Engineer are well aware of the energy, pertinacity and shrewdness with which Mr. Wessels has advocated the claims of the air brake to adoption in the street railway field; and it will be a pleasure to all to know that the Standard brakes have not only become well known in this country through his work, but are now in use all over the world. With tongue and pen, by personal interview and brilliantly clever advertising Mr. Wessels has sought to make his point, and has scored every time. It is to be hoped that Mr. Wessels will stay within the charmed circle of electrical affairs, but the inducements offered in every direction to a man so competent and able are such as to make the electrical field but one opportunity among many.

MR. C. O. BAKER, JR., has just returned from a two months' trip all through the West, the Pacific Slope and the Northwest. He is very much encouraged by what he has seen of conditions there and of revived trade and prosperity. He saw abundant evidence also of Klondike richness, and says he would not be surprised to see gold coming out by the ton this year.

MR. S. M. HAMILL, of the Brush Electric Co., was a visitor in New York City last week, and a welcome caller at The Engineer office. His forecast of lighting business in 1898 is very rosy. He believes that the new incandescents put in will run up into millions, but pins his faith also on a few hundred thousand more arcs—chiefly good old Brush.

MR. HORATIO A. FOSTER is giving a series of popular talks before the Real Estate Exchange, Buffalo, on Niagara power and its applications and possibilities.

SOCIETY & CLUB NOTES

An Important Lecture by Mr. S. D. Greene.

At the College of the City of New York, Lexington avenue and East 23d street, at 8 p. m. on Wednesday, January 12, Mr. S. Dana Greene will deliver a lecture before the New York Electrical Society, which hereafter will hold most of its meetings at the city college, by special permission. Mr. Greene, who has already made valuable contributions to the society's work, has chosen a most interesting and timely topic, viz., "The Relations Between the Customer, the Consulting Engineer and the Electrical Manufacturer." The society cordially invites any one to be present reading this announcement, and welcomes accessions to its large and growing membership.

Improved Robertson-Thompson Indicator.

THE improved Robertson-Thompson indicater, illustrated in the accompanying engraving, Fig. 1, which has just been placed on the market, is unusually heavy, but as a result of most careful experiment this weight is so perfectly distributed that the best results may be attained at speeds far in excess of any met with in actual practice. One of the most serious errors in ordinary indicator work is caused by flexure of the arm which carries the drum, particularly when the cord is carried above or below the instrument. In this manner an error of 10 per cent. is easily possible, particularly if the instrument is being used with a high-pressure spring. For instance, with an 80 spring, it would require a movement of but one-eightieth of an inch to show an error of one pound. In many cases weakness at this point will account for the curious features often noticed at the junction of the admission and steam lines on the diagram. The drum-carrying arm of the improved Robertson-Thompson indicater is so stiff that no error from this cause is possible.

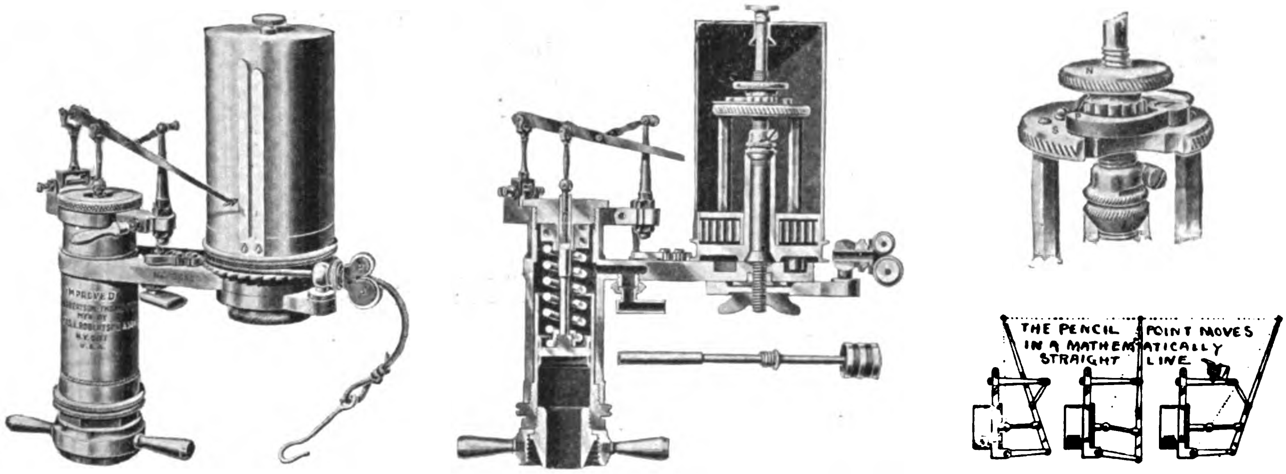
The cylinder is steam jacketed, and by its construction the possibility of the piston being cramped as a result of external strains is precluded. The area of this cylinder is exactly one-half inch, and each spring is suitable for twice the pressure stamped on it; for instance, a 60 spring may be used for a pressure of 120 pounds or less. The coupling is reamed to one-quarter inch area, and with each instrument an extra one-quarter inch piston is furnished, as shown in Fig. 2. With this piston each spring may be used for pressures four times as great as the number stamped thereon, so that with a 60 spring 240 pounds may be safely indicated. This extra piston is of special value for hydraulic and gas engine work.

The pistons are made of steel, but phosphor-bronze will be substituted if preferred. The piston springs are standardized by the most approved testing apparatus, in connection with a mercury column. To guarantee against pressure above the piston a large relief opening has been provided, the outlet being a neat swivel elbow by means of which the "blow" may be discharged in any direction, at the will of the operator. Each instrument is provided with a detent or stop motion.

In Fig. 3 a new device is shown for adjusting the tension of the drum spring. By rotating the knurled head S to the right, the spring may be tightened as much as desired and securely held by pawl P; the ratchet wheel N is securely attached to the shaft by means of a left-hand thread. Thus the tendency of the drum spring is to tighten this ratchet nut more firmly. By pressing the thumb into the recess in the spring winder S the pawl is released, when the tension may be diminished to any desired amount. This ratchet wheel has 16 teeth, which provide for the adjustment of the spring to a nicety. The drum springs are of the clock type, but the spiral form will be furnished if preferred. Cone bearings are provided to take up all wear of the drum steel. The parallel movement is made of tool steel, highly polished and richly blued. All bearings are wide and perfectly fitted.

In Fig. 4 the pencil mechanism is shown in three positions, which will give a perfect idea of the manner in which an absolutely correct straight line is obtained. This movement forms a perfect pantagraph, so that the pencil movement is exactly proportional to that of the piston, the ratio being 5 to 1.

All moving parts are worked down to the lightest weight consistent with durability. For comparison it may be stated that the drum weight is but 1¼ ounces, and the pencil lever 25 grains. By special order the instrument will be fitted with the improved Victor reducing wheel, which comprises the usual cord-feeding device. The manufacturers are James L. Robertson & Sons, No. 204 Fulton street, New York.



FIGS. 1, 2, 3 AND 4—IMPROVED ROBERTSON-THOMSON INDICATOR.

Ferracute Machine Co.

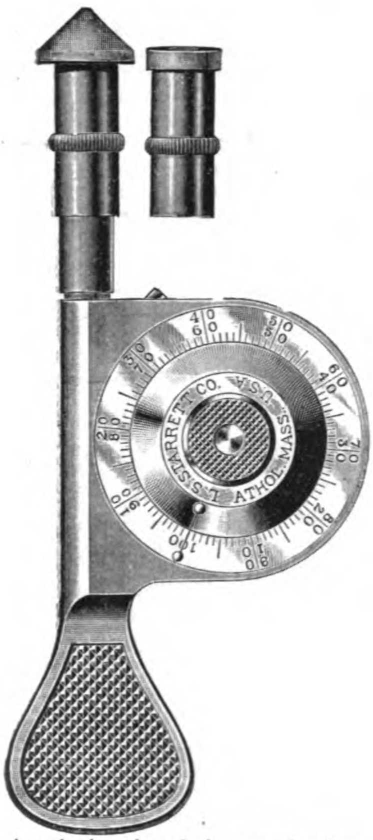
The Ferracute Machine Co., of Bridgeton, N. J., make a specialty of presses and dies for cutting out and notching armature discs, and various other electrical work. They build a full line of large round bed presses for cutting out the discs, and two different styles of presses for notching the discs. The smaller of these cuts 200 notches per minute, and any number of notches in discs varying from 4 inches to 40 inches in diameter. The large machine is a special one for discs above 40 inches up to 12 feet in diameter. They have recently sent out a number of these notching machines to France and other foreign countries; also a number of their other presses weighing from 12,000 to 16,000 pounds each for cutting out discs and other general work. They have also shipped four of these large presses to the Westinghouse Electric Co., of Pittsburg and several other smaller presses to other firms. They have recently enlarged their shops, and are running from 140 to 150 hands. They are just issuing a large poster or circular which they will mail to all parts of the world, and have commenced work on a new catalogue, which will be out in two or three months. They are constantly adding new designs of presses to their already large list, and are producing various improvements so that their presses embody all the most recent improvements in the line of goods they make.

Henry R. Worthington.

Henry R. Worthington are contemplating enlargements of their present storage capacity for castings for their standard sizes of pumps. They now carry in storage from two to three months' supply of all standard castings of six-inch stroke pumps and smaller sizes. It is now proposed to extend this system to standard pumps of much larger sizes.

BURR & HOUSTON CO.—A visit to the foundry of the Burr & Houston Co., 33-39 Franklin street, Brooklyn, N. Y., will show a large force of men at work turning out grey iron castings in large quantities. This firm makes a specialty of these castings for electrical and machinery purposes, etc.

L. S. Starrett Co.'s High Speed Indicator.

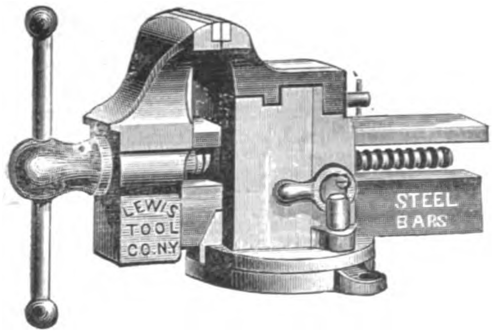


WE referred recently the excellent mechanical tools, tool cutters, etc., made by the L. S. Starrett Co., of Athol, Mass., and at the same time illustrated and described one of their latest micrometers. We now have opportunity to show their No. 104 Starrett high speed indicator, another specialty on which they pride themselves. It is, as will be seen, a very neat, compact and well made piece of apparatus, and the price is very low indeed. This indicator may be run at very high speeds without heating, and this on account of the frictionless bearing against which the inner end of the spindle revolves. The working parts of this instrument are encased, and the dial plate has two rows of figures, reading right or left, as the shaft may run.

The inner plate is frictionally clamped to the revolving gear by a checked wafer head screw. By a pressure and twist with the thumb the plate is loosened, when the o mark may be instantly moved to agree with the starting point, thus saving time revolving the spindle to bring it there. Several new features are under new or pending patents, and a variety of styles or indicators for special work can be had. An important improvement which is now applied to all of their speed indicators, consists in substituting for the hardened steel pointed spindle and split caps, rubber tips for both pointed and centered shafts, which not only remove the jar and run smoothly, but produce a stronger frictional contact between the shaft and the instrument.

The Lewis Patent Vise.

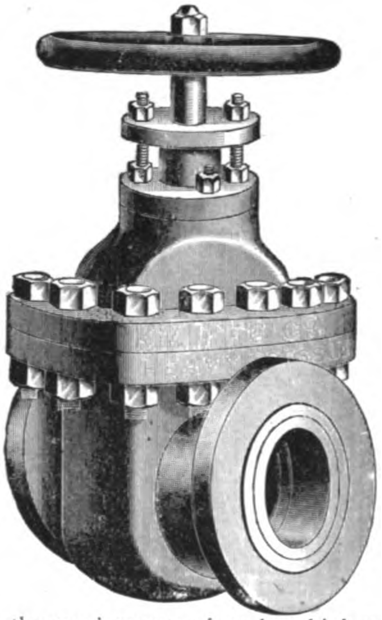
AMONG the many vises which of recent years have been put on the market there are probably few that can boast all the combined features of merit which the Lewis' patent vise embodies. It can readily be seen from the accompanying cut that the slides are two flat bars. The upper bar is mounted above the screen with flat surface horizontal, while the other



THE LEWIS PATENT VISE.

bar is below, with flat surface in perpendicular position to the screw. By this arrangement a perfect resistance is secured for the jaw, against both sidewise and downward strains, and at the same time it gives sufficient elasticity to stand shock of chipping and riveting, an advantage claimed over other parallel vises. The position of the upper bar thoroughly protects the screw, yet it can be readily oiled without removing the slide. The nut is placed at the center, instead of the bottom of the vise, thus adding greatly to pressure and firmness of grip. The winged supports on the nut rest firmly against the body of the vise. The nut fits loosely in the rear end of the socket, thus allowing it to line up with the screw, which prevents it from cutting and obviates the rapid wear complained of in vises having a nut dovetailed in the bottom, liable to spring out of line when under strain. The nut is easily and cheaply renewed when necessary. There are quite a number of other features too numerous to dwell upon in this article. The Lewis Tool Co., 44 Barclay street, New York, are the manufacturers of these vises and have placed their goods with such concerns as the General Electric Co., Pratt & Whitney Co. and many other large concerns throughout the country.

The Kennedy Steam Valves in the Union Edison Station, Brooklyn.



THE great care bestowed on the design and construction of the great new Union Station of the Brooklyn Edison Co., described one of their latest issue, has been carried out to the smallest detail. The steam valves are by no means the smallest consideration in such an installation and in the present instance only the most approved types were employed. Among these were the Kennedy valves, manufactured by the Kennedy Valve Mfg. Co., of 75 John street, New York.

These valves, illustrated in the accompanying engraving, are of their extra heavy pattern, especially designed to fulfill the requirements of modern high pressure steam plants. They are made of the best close grained cast iron, with heavy bronze seats and mountings, and are capable of resisting all strains due to expansion and contraction of water hammer. The bronze seats are very heavy, screwed home to a faced shoulder, which makes a perfect joint, and can be easily removed if necessary. The stems are large in diameter, with deep stuffing boxes, which have an arrangement on the inside whereby they can be repacked without closing the valve or shutting off the steam. These valves are made with inside and outside screw and yoke, with or without by-pass.

LEGAL NOTES

The Stieringer Fixture Litigation.

The N. Y. Law Journal of last week announces the decision of Judge Pryor in the case brought by Luther Stieringer against Richard N. Dyer and George Maitland to secure from them an accounting and payment of Stieringer's share of the income derived since 1888 from the well known Stieringer fixture patents. Up to the time of the action Dyer and Maitland had collected about $120,000, of which they gave Stieringer $15,000. Dyer and Maitland denied that Stieringer was their partner under the contract, but Judge Pryor holds that they were partners and has decreed a dissolution of the firm, an accounting to Stieringer and the appointment of a receiver who shall henceforth manage the business.

THE BRIDGE TROLLEY CARS were set going December 31, the injunctions in the way having been swept aside by the courts of review. Mr. T. L. Johnson rode in the first car across on Friday night.

TRADE NOTES & NOVELTIES

Standard Thermometer & Electric Co.'s Enclosed Alternating Arc Lamp.

WE illustrate herewith the indoor type of the enclosed arc alternating current lamp manufactured by the Standard Thermometer & Electric Co., Peabody, Mass. It is very simple in construction, burns steadily and without noise. It makes a very handsome appearance, and the cover can be finished in any color desired. On 16,000 frequencies the lamp operates direct on secondary circuit at from 100 to 125 volts without transformer or resistance. Where the lamp is desired to operate on 7,200 frequencies, an induction coil is provided and placed in the cover. The maker guarantees for this new improved lamp a life of at least 120 hours, with one set of carbons, at an average current consumption of from 360 to 400 watts. With clear globes a nominal candle power of 1,000 to 1,200 is obtained.

The mechanism of the lamp is held in the cover in such a manner as to confine the vibrations, preventing noise, either from the arc or metallic parts. The clutch of the lamp is provided with a spring, which prevents the carbons from slipping. The trimming device and inner globes, as well as outer globes, are the same on this new type of lamp as on the improved enclosed arc lamps of all other types made by this company. For outdoor service the lamp is provided with a hood and arm. It is shipped from the factory all ready for installation.

Forty Years of Light-giving.

THE firm of I. P. Frink, 551 Pearl street, New York, has for forty consecutive years jealously guarded its reputation for fair dealing, and the superior quality and construction of its reflectors. Successful from the start, it has kept pace with this age of light, improving quality and construction, so that the 1897 reflector would hardly be recognized as a distant relative of the 1857 type.

During this time it has lighted over twenty thousand churches, in nearly every country in the world, and thousands of halls, theatres, armories, schools, hospitals, court houses, stores and public buildings, receiving the first prize, medal and diploma at the World's Fair, Chicago, 1893.

Although advertising "The Great Church Light" extensively, the firm does not confine its efforts to churches only, but has lighted a number of the finest private mansions in the principal cities of America, recently lighting a reception room in New York, in which over one hundred thousand dollars was expended on interior decorations, four thousand of which was for the Frink reflectors for lighting the rooms. The reflectors were heavily plated in gold.

The new Corcoran Art Gallery, Washington, D. C.; the Rhode Island School of Design, Providence, R. I.; Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y.; and Hart Memorial Library, Troy, N. Y., have recently been lighted by Frink reflectors and there are now on hand good orders from Africa, China, England and France, and from churches in nearly every State in the Union, which goes to show the widespread popularity of the Frink reflector.

During the holidays orders are frequently received by telegraph, giving size of room to be lighted, with no previous correspondence. This clearly indicates the esteem in which the firm is held by the general public. Its facilities for turning out good work promptly are more perfect than ever before.

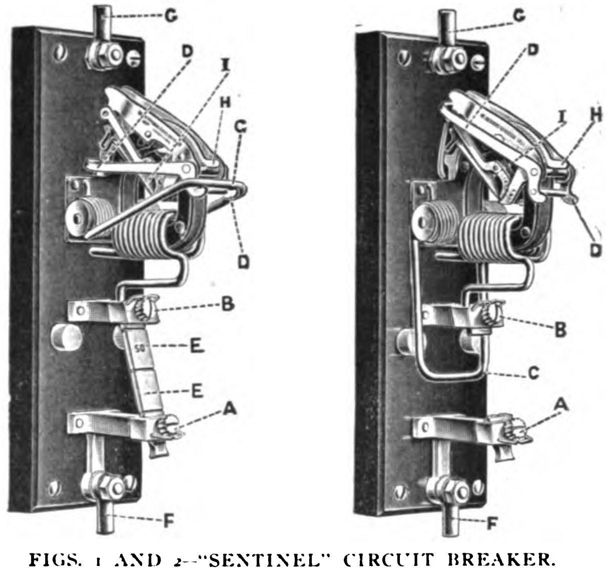
The firm invites correspondence on the subject of lighting and sends its Book of Light free, on request.

New Sentinel Circuit Breaker.

REALIZING the demand for an electro-magnetic device to replace fuses and appreciating the danger of substituting "secondary-break" circuit breakers, especially in cases where constant inspection and attention are impracticable, the inventors of the Sentinel electric circuit breakers have succeeded in perfecting a device which is absolutely reliable, positive in its action at all times, and which may in all cases replace fuses with entirely satisfactory results, requiring only an annual inspection.

The various sizes of the type herewith described are adapted to the protection of circuits of from 6 to 200 amperes, alternating or direct current, at any voltage up to 250, and are furnished in single pole, double pole or triple pole, with either front or back connections.

Referring to Figs. 1 and 2, the main terminals are at F and G, part of the circuit being composed of the metal bar EE, which is made of a brittle, non-arcing alloy. Upon the discharge of the circuit breaker the spring C breaks out the sections EE of the bar as shown in Fig. 2, thus insuring an absolute disruption of the circuit. When setting the circuit breaker with the upper mechanism DD in the position shown in Fig. 2, the spring C is lifted until it raises the trigger H, when the lever D will fall and the spring C remain set. The screws A and B are then loosened and a new bar is inserted and clamped securely by the screws.



FIGS. 1 AND 2—"SENTINEL" CIRCUIT BREAKER.

The following salient features are claimed for these circuit breakers: 1. The circuit once broken can never be closed by the same piece, and the necessary insertion of a new bar insures a perfect connection each time the device is recharged. 2. No moving part of the mechanism is connected with the circuit and once charged it only requires an annual inspection, not being affected by changes of temperature or dampness. 3. The breakers are adapted to both alternating and direct current circuits with a maximum efficiency and accuracy of calibration. Owing to the fact that they have no appreciable

"lag," fuses may be replaced with no increase in the total losses. 4. But few screws are used in the mechanism and these are locked and cannot be loosened by vibrations, neither will vibrations of any nature affect the "set" or discharging point of the breaker. 5. When employed as a protective device for light services it may be operated with perfect satisfaction without the aid of a switch in series with it to finally close the circuit after charging the breaker. In the event of an abnormal load of momentary duration, the breaker may be set and the circuit closed by the insertion of a new bar. When discharged by an abnormal load or short circuit of a more serious nature, the spring C may be set and a new bar inserted until it touches the upper bar holder, when the spring C will be discharged and effectually break the circuit without any danger or injury to the operator.

The Sentinel Electric Co., of Wilmington, Del., who manufacture these circuit breakers, have also perfected a Combined Switch and Circuit Breaker which is specially adapted for the protection of motors furnishing power for machine shops and factories.

G. E. Electro-static Ground Detector.

THE General Electric Company announces a new ground detector to take the place of the transformer and a lamp method, which, although hitherto extensively used, has never given more than a rough indication of the condition of the lines. In the transformer and lamp method of ground detection, the extent of the ground is indicated by a lamp in the secondary circuit of the transformer, but on account of the capacity of the lines the lamp nearly always glows, and the actual condition of the line is difficult to ascertain.

The new device here illustrated is a switchboard instrument. and is similar in construction to that of electro-static voltmeters used in laboratory work. Briefly, it consists of four rigidly fixed sheet metal quadrants, between which is space for the accommodation of a vane carrying an indicating needle. The two lower quadrants are connected internally to the lower binding post for connection to the ground; the two upper to the right and left binding posts respectively for connection to the lines. The vane with its needle is pivoted at the center of the

G. E. ELECTRO-STATIC GROUND DETECTOR.

circle formed by the four quadrants, and is slightly counterweighted to balance the weight of the needle.

In common with all electro-static instruments the operation of this ground detector depends on the tendency of the vane to place itself in the position giving the greatest condenser capacity. If no ground exists on the line the vane lies across the shortest path between the positive and negative quadrants,—the right and left upper quadrants—and the needle points to zero. If, however, either side of the system be grounded, the two lower quadrants cease to be neutral, the system is out of balance, and the vane, taking a new position, deflects the needle to the right or left, indicating the grounded side. A special feature of the construction is that the moving mechanism is insulated and has no electrical connection with either side or with the ground. If it were connected to either side of the line or to the ground, a burn-out might possibly result, but being insulated, the moving mechanism can come into contact with one of the quadrants, without causing any damage. It may be used for temporary connection to any desired line or one for each feeder may be permanently installed.

This electro-static ground detector is constructed for 1,000, 2,000, 5,000 and 10,000 volts, and is set in a black japanned case with cover finished in polished nickel.

Shelby 220-Volt Lamps.

The Shelby Electric Co., of Shelby, O., are out in this issue with the largest advertisement ever made on 220-volt lamps. The remarkable tests which they claim to have made have encouraged them to go in for the specialty of lamps of high voltages, and they are able to furnish lamps of any efficiency from 3.3 watts to 4½ watts per candle power that will show as good life as the average lamps of the same efficiencies in the lower voltages. It will be remembered that they advertised in these pages quite extensively in the early spring time, and the result of this advertising has been so profitable to them that they have been constantly behind their orders ever since. They have now increased facilities for manufacturing and think they will be able to ship promptly any orders sent them. There seems to be a great future ahead for 220-volt work.

Sulphuric Acid for Storage Batteries.

The rapidly increasing demand for storage batteries marks a radical departure from methods heretofore followed in the operation of illuminating and street railway plants, and the demand will increase as the use of accumulators commends itself to owners of large plants.

In the operation of these batteries sulphuric acid is used in large quantities, but much difficulty has been experienced in getting acid of the desired quality. In the past there existed a prejudice against sulphuric acid made from pyrites, which has since been overcome owing to improved methods of manufacture, and to-day, it is said, pyrites acid is manufactured of a quality equal to any acid made from brimstone, and superior to much of the acid made from that material.

The Gasselli Chemical Co., of Cleveland, O., are large manufacturers of sulphuric acid for storage batteries, which is free from all impurities, and prospective buyers of acid or other chemicals for electrical purposes, would do well to correspond with that company.

Owing to their numerous branches, they are in position to supply the trade in any section to the best possible advantage.

Their general office is in Cleveland, O. The New York office is at 63 and 65 Wall street. They have large manufacturing plants at Tremley, N. J.; Cleveland and Chicago, Ill., from any of which the trade can be supplied; also, branch offices and warehouses at Cincinnati, O.; St. Louis, Mo.; Milwaukee, Wis., and St. Paul, Minn.

We learn from them that the demand for this special sulphuric acid for storage batteries has been heavy.

The Monarch Cigar Lamp.

There are evidently other uses to which an incandescent lamp bulb can be put, besides holding a filament and a vacuum. We judge so from the fact that we have enjoyed a fragrant havana which reached us securely packed within the bulb of a "Monarch" candelabra lamp with a removable base to extract the weed. Although we do not know the price of these new lamps, the Western Electrical Supply Co., of St. Louis, may book our order for a couple of barrels of them on the same terms as the sample.

The Ferguson Year Book.

Mr. John W. Ferguson, builder and general contractor, of 253 Broadway, New York, has sent us a beautiful "Year Book for 1898." A page is devoted to every day of the year, allowing of ample room for recording memoranda and engagements The book is bound in Russia leather, with flexible covers, and is a decided ornament to our desk.

Standard Telephone & Electric Co., Madison, Wis.

The Standard Telephone & Electric Co., of Madison, Wis., are securing some excellent business throughout the Northwest. Their business has been of a steady and reliable character from the beginning, and the general satisfaction expressed by purchasers of the Standard apparatus only strengthens its popularity with old and new purchasers alike. The company is one of the most progressive in the competitive telephone field and is constantly putting upon the market new and meritorious devices for telephone exchange work. In the very near future a full line of novel switching apparatus will be introduced, possessing in some particulars many new and striking features. The very successful experience this company has had with its switchboards relieves it from the necessity of putting upon the market anything of an experimental character, as those principles which it has demonstrated to be most appropriate in telephone exchange apparatus will be adhered to in the development of anything of similar character.

Gold's Patent Improved Electric Car Heater.

THE principle of supporting the resistance coils of an electric heater on enameled spirals which has been put in practice by the Gold Street Car Heating Co. has proved such a decided success that the president of the company, Mr. Edward E. Gold, has recently devised and constructed a new form of electric heater which fits into the panel under the seat and the face of which heater is flush with the panel.

The results obtained from very extensive tests made with this new construction of heater have so conclusively proved its superiority that the Gold Company have arranged it to fit into the cases of heaters which are already applied to the cars.

The accompanying illustrations show two views of this new heater. Fig. 1 shows it fitted in and screwed fast to the panel. At the left is shown a three-point regulating switch. In Fig. 2 the front is removed and the interior construction is exposed.

As may be seen, three spiral rods are supported longitudinally by a solid porcelain block at either end. These spirals are made of 5-16-inch steel rod and are thoroughly covered with glass enamel, which is baked on at over 2,000 degs. F. This enamel is of course a perfect insulator and is not affected in the slightest degree by the heat of the resistance wires.

The resistance wire, which is the same composition as heretofore used in the Gold electric heaters, and which is the company's own special composition, having been originally produced by this company especially for heating purposes, is wound into a coil of about half an inch diameter. It is wound under an open tension and when slipped on to the enameled spiral it is in its natural condition and is not spread out under a tension.

When the resistance wire is originally wound on an open pitch there is no tendency for it to lose its original condition nor does its position change in any way.

The new improved Gold electric heater affords the freest circulation of air over the heated surfaces. It will be noticed in Fig. 2 that there is no core to obstruct the passage of the air through the heater. It has always been a predominant point with the Gold Company to have an easy and free circulation of air passing through the heater and as a result this improved construction will produce an equal amount of heat and, it is claimed, use at least 20 per cent. less current in so doing than is usually required.

The construction of this new heater also admits of three gradations of heat on each individual heater. A three-point switch is used in connection with it, the first point of which throws in the botom coil of every heater in the car. The second point cuts out the bottom coil and throws in the upper two coils of every heater, and the third point throws in all three coils in every heater in the car. In this way a perfectly even and uniform temperature is maintained at all times, so no matter at which point the switch is turned, the same amount of heat is being distributed from every heater in the car and no heater or heaters are cut out.

The Gold heater is perfectly insulated in every way and is lined with asbestos and provided with an air space at the back to prevent loss of heat by radiation from the back of the casing. A large number of electric heaters constructed on this principle have been put on the market and in every instance the results obtained have been all that could be desired.

FIG. 1—GOLD PATENT IMPROVED ELECTRIC HEATER.

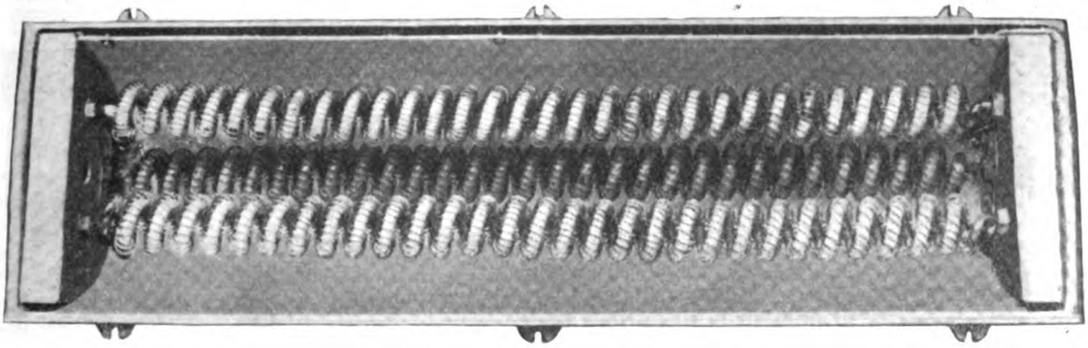


FIG. 2—INTERIOR OF GOLD ELECTRIC HEATER.

MR. GEO. W. PATTERSON has recently been appointed Western representative in charge of the office of the American Circular Loom Co., at 1114 Marquette Building, Chicago. Mr. Patterson is known to the trade through his connections as Western agent for the Gordon-Burnham and Law primary and Ohio storage batteries, and Medbury knife switches and overhead railway material, which he will still represent.

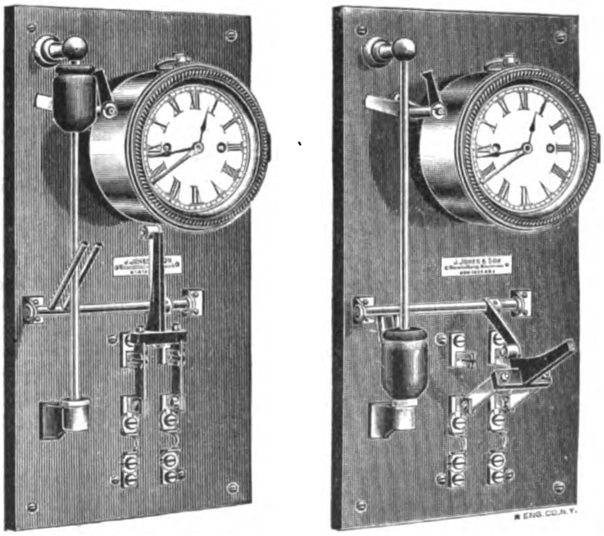
Star Dry Battery.

THE Star Dry Battery Co., 143 Eighth street, New York, are manufacturers of the Star dry battery, which is fast growing into good demand, owing to its superior qualities. The battery is different in construction from others now on the market, and has a high voltage, from 1.5 to 1.6. Its regenerative powers are highly marked and it loses no strength while remaining inactive. The battery can be used for telegraphs, telephones, annunciators, railway signals, electric gas lighting and all open circuit and intermittent work. It is manufactured in the four standard sizes. The Star Dry Battery Co., are the manufacturers also of the New Excelsior Battery, which is exceedingly reasonable in price. They are also manufacturers of the Multiple X-Ray Star Battery for use in conjunction with spark coils.

The Jones Automatic Time Switch.

MESSRS J. JONES & CO., manufacturers and dealers in electrical supplies, New York, have put on the market their new and ingenious time switch, shown in the accompanying illustration. It consists chiefly of a standard 35 ampere fused all copper switch, suitably mounted, so that it can be wired from the back or front, together with a one-day nickel plated clock of good manufacture, all mounted upon a block of enameled slate base ready to be screwed to the wall. The clock is arranged so that at any predetermined time within the 12 hours it will release a weight, which, by falling, opens the switch and circuit.

In the construction of this device Messrs. Jones & Son have succeeded in producing a simple mechanism, thus avoiding all complications in setting or operating. The switch is purely



FIGS. 1 AND 2—JONES AUTOMATIC TIME SWITCH.

mechanical in action, strongly built and has ample electrical capacity in the switch and fusing parts.

It would hardly be necessary to mention in this article the many purposes for which this automatic time switch can be used to good advantage; however, particular attention is called to its great value in reducing the average electric light bill wherever installed.

Among the many uses to which this switch can be applied is in conection with the lighting of show windows during the early part of the night. Then again, there are numerous instances in which electric lighting companies desire to furnish light, but in which it would not pay to send a man to switch off the current.

The low price at which this switch is sold is not the least of its good points.

Messrs. Jones & Co. also make another switch which not only switches off the current, but switches it on again at any predetermined time. One of these latter switches is at present working in connection with the large sign of the North River Savings Bank on 34th street, near 8th avenue, New York.

The Crescent Telephones.

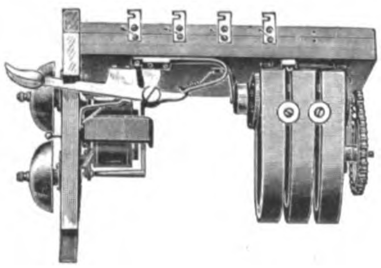
THE Pennsylvania Electric Co., of Marietta, Penn., has just brought out a line of telephone transmitters, the invention of Mr. Paul W. Bossart, manager of the company.

These instruments, which are illustrated in the accompanying engravings, possess a number of novel features, the utility of which will be readily recognized. In the first place they are so designed that they can without any inconvenience be placed

THE CRESCENT TELEPHONES.

in corners or closets, owing to the fact that the mouthpiece can be turned and adjusted at any desired angle both horizontal and vertical, in contradistinction to the present usual style which can only be adjusted vertically. But notwithstanding this universal adjusting facility, the transmitter always remains in a horizontal position, thus preventing packing of the carbon granules.

Another exceedingly valuable feature of the Crescent telephones is the ability which they afford of removing the working parts complete from the body of the cabinet for adjustment or inspection. This is accomplished by opening, at one move-



"CRESCENT" TELEPHONE MAGNETO BELL.

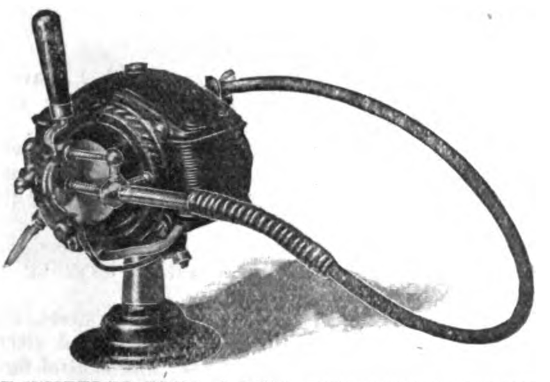
ment, four sliding contacts; these contacts, when closed in position firmly hold the working parts in places.

Besides these important features there are others, all of which are the results of twenty years' experience in telephone work and the Pennsylvania Electric Co. feel that in their Crescent telephones they are offering a first-class instrument in every respect.

WARREN ELECTRIC & SPECIALTY CO., of Warren, O., have issued a large and pretty calendar, in colors. There is a large central figure, which might be taken for a very good likeness of Mrs. Miskel-Hoyt.

The Wheeler Elec. & Mfg. Co.'s Dental Engine.

THE various applications of electricity to dental work have made a considerable tax on the ingenuity and skill of inventors, for it is obvious that in work of such precision and delicacy the apparatus must be well designed and well built to be in any degree successful. Dental drills, for example, when driven by electricity, require very neat adjustments. The Wheeler Electric & Mfg. Co., Dayton, Tenn., are now putting on the market the compact and effective mechanism here shown. This novel electric dental engine depends upon mechanical



THE WHEELER ELEC. & MFG. CO.'S DENTAL ENGINE.

means for the regulation and control of the drills, which can be started, stopped, reversed, etc., quite independently of the number of revolutions of the motor armature. These machines are built to operate on either battery or lighting current, direct or alternating, and are so simple in construction any dentist can handle them easily without having previously to acquire the whole art of electricity. The Wheeler Co. will be glad to receive inquiries and answer correspondence in regard to this or other specialties.

Wagor's "Acme" Guard for Incandescent Lamps.

A cut is shown herewith of the patented "Acme" wire guard for incandescent lamps, made by P. R. Wagor & Co., 275-9 Main street, Springfield, Mass., who make a large line of shades, holders, guards, etc., for electric and other lights. The Acme guard is simple, durable and easy to fix or detach, if desired, and it has gone into very general use. The firm have very good reports from customers and users, and find that their guard business during the past year has been something phenomenal. They will be glad to receive and answer inquiries on the subject from any of our readers.

Hart Switches in 1898.

The Hart & Hegeman Mfg. Co., of Hartford, Conn., manufacturers of the well known Hart snap switches, report business conditions as satisfactory and the outlook for 1898 as bright. Hart switches have been before the electrical public since 1890 and have always borne an enviable reputation for high quality. This company claims that there is a growing appreciation of the fact that a switch has more actual work to perform than any other portion of an electrical circuit and therefore should be selected with care and with due regard to its mechanism and lasting qualities. While competition has caused some manufacturers to lessen the cost of their product at the expense of quality, the motto of the Hart & Hegeman Mfg. Co. has always been "quality first" and whenever it was apparent that an improvement could be made, even at increased cost, the change was promptly adopted. The result of the adoption of this high standard in manufacturing places Hart switches to-day before electrical men in shape that it is hard for the most critical to find fault with; and this care in manufacturing, combined with strictly honorable and courteous business methods, results in the prosperity which it is our pleasure to record. It may not be out of place to add that notwithstanding the great improvements made in Hart switches during 1897 no advances were made in selling prices.

The O. K. Dry Battery.

THE demand for dry batteries for commercial use in preference to various forms of sal-ammoniac have brought out a number of dry batteries, good, bad and indifferent. Among the good ones there is one on the market which has brought to its makers scores of unsolicited testimonial letters and large orders. It is the O. K. battery manufactured by the Non-Polarizing Dry Battery Co., 625 Broadway, New York City. The battery bears every evidence of substantial construction, enabling it to stand the severest test in the way of long life, etc. The materials and chemicals used are of the best and purest, and are said to be combined in a manner radically new and different. Among the many advantages claimed for the O. K. battery are: Polarization reduced to a minimum, freedom from all local action, great recuperative powers, remarkably high voltage and amperage, compactness, indifference to heat or cold, etc. Prof. F. B. Crocker, of Columbia University, recently reported a test made by him on batteries (type B) of the O. K. make. The first of these reports shows that the battery maintained an average of about 1.1 volts and .22 ampere for 88 hours. This is an average of .24 watt or 20 watt hours for the total run. The second test shows the results obtained starting with a current of .55 ampere. In this case the average power was .413 watt for 44 hours, or about 18.2 watt hours. The slight diminution in watt hours was due to the higher rate of discharge. The other three reports show the results obtained

THE O. K. DRY BATTERY.

with rates of discharge, beginning at 1.1 and 2 amperes and a dead short circuit, respectively. The first of these shows that 14.52 watt hours are obtained even when the current starts at 1.1 amperes and averages about .7. But the last two reports represent excessive rates of discharge. Even on a short circuit, however, the battery starts at 8.5 amperes and still gives 3 amperes after one hour's run.

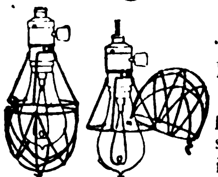
The curves show that the battery would have continued to give current for a considerable time after the tests were stopped, but as the time occupied was 88 hours in one case and 44 in another, it was not feasible to continue any longer. It was evident that the total output would have reached at least 30 watt hours, even at the discharge rate of .2 ampere. At a lower rate of say .1 ampere a still higher output of 35 or 40 watt hours could undoubtedly be obtained. Even after running the battery for 88 hours, and obtaining 20 watt hours from it, it was found that the volts rose to 1.33 after a rest of 48 hours, showing that the battery had recuperated almost to its original voltage, and still contained considerable energy.

The O. K. dry battery is made in five sizes, from 1½ by 4 to 3 by 7 inches. Its e. m. f. is 1.5 volts, and the internal resistances vary between .15 of an ohm and .3 of an ohm.

The Non-Polarizing Dry Battery Co. numbers among its many customers such concerns as N. Y. Central & Hudson R. R. Co., N. Y., N. H. & H. R. R. Co., Pennsylvania R. R. Co., Pullman Palace Car Co., Long Island R. R. Co., Backus Water Motor Co., Otto Gas Engine Co., Pierce Engine Co., Western Electric Co., Chicago Telephone Co., Western Union Telegraph Co., Bell Telephone Co., of Montreal, and Toronto, Canada; Self-Winding Clock Co., Keystone Telephone Co.,

Pittsburg, Pa.; Oregon Telephone Co., Portland, Ore.; Electric Gas Lighting Co., Boston, Mass.; Central Electric Co., National Switch & Signal Co., Easton, Pa.

Inglis "Perfection" Lamp Guard.



We illustrate herewith the improved "Perfection" lamp guard, made by the Wm. Inglis Wire & Iron Works, of Detroit, Mich., and sold by them at remarkably low prices. They are neat and firmly built, and stand wear excellently. The guard opens in such a manner that the incandescent lamp it protects can be handled without detaching the guard from the socket, and it has other similar features of merit. The Inglis Works will be glad to send a sample for inspection. Our cuts show the guard open and closed.

Burnt-Out Lamp Renewal.

The idea of renewing burnt out lamps, originated by promoters of the Lynn Incandescent Lamp Co., seems to be meeting with their most sanguine expectations. Their business has developed into one of considerable proportions and they were again favored this week with an order from their first customer. They have established offices in New York, Baltimore, Cincinnati, and Chicago. This company will renew lamps to any voltage or candle power up to 32, and to any efficiency desired. They claim that an old lamp with a new filament is in every way equal to a new lamp; and the rapid growth and the increasing popularity in the business seems to demonstrate that they are correct.

Chas. Beseler's Son.

Chas. Beseler's Son, of 218 Centre street, New York City, manufacturer of stereopticons, etc., has recently purchased the entire plant of the defunct firm of Peters, Mantz & Co., of 125 and 127 Worth street, and with their additional machinery and a large number of the most modern machines also purchased, he is now in a position to construct stereopticons and all instruments (scientific, electrical or otherwise) to much greater advantage than hitherto. This firm's name is known all over the world for reliable workmanship and reasonable prices. Intending purchasers would do well to send for illustrated catalogue and price list.

Otis Elevator Push Buttons.

A very ingenious, useful and up to date improvement in the running of their private house elevators has been brought out by Messrs. Otis Bros. & Co., of 54 Park Row, New York City. Briefly stated each hall of the house is provided with a single push button, which, when operated, brings the elevator to the floor at which the passenger waits. Upon arriving, the elevator automatically operates a mechanical door fixture or hall door, which allows the latter to be opened. Otherwise the door is securely locked and cannot be opened from the hall. Electric door contacts are also provided, the object of which is that if, in case, by the merest chance, a door is open on any of the floors leading to the elevator, it would be impossible to start the elevator, owing to the circuit being broken, necessitating first the closing of the door wherever it may be. Push buttons are provided in the elevator and are numbered to correspond with the floors of the house. It is only necessary for a passenger to push a button corresponding with the floor desired to be reached, the elevator thereupon proceeding to the floor, stopping at its destination automatically. An extra push button is also provided in the elevator which enables the operator to stop immediately while in motion, thus enabling the car to proceed in a different direction if change of course is deemed convenient by passenger. It can readily be seen how simple and yet to what degree of effectiveness the push button arrangement in the Otis elevators has been brought, enabling the most inexperienced person to operate a house elevator of the company's make with absolute certainty. A large number are now in operation throughout the country.

WM. E. KLINE & CO., 123 Liberty street, will be pleased to mail their catalogue with prices of their miniature lamps, standard incandescent lamps, sundries, etc., on application.

Partrick, Carter & Wilkins.

One of the best known firms in this country as manufacturers of electrical supplies and domestic electrical specialties are the Partrick & Carter Co., of 125 South Second street, Philadelphia, whose record goes back to the "year one." A change has now been made in the style of the firm, which hereafter will be known as Partrick, Carter & Wilkins. The members of the house under this style are Franklin S. Carter, Chas. M. Wilkins, and E. Ward Wilkins. We trust that under the new flag the old house may add to its long list of victories, through many years to come.

Calendars.

American Electrical Works, Providence, R. I., have favored us with a handsome calendar showing their fine factory in colors. It is an ornamental addition to an office.

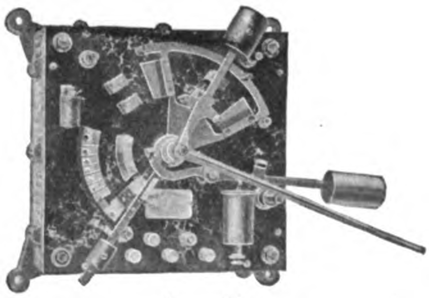
Direct U. S. Cable Co. are out on time as usual with their pad calendar. The supporting card this year is printed in a quiet lavender tint and has a pretty design showing the company's system.

Pope Mfg. Co. favor us with their desk pad calendar, whose daily legends sing the praises of bicycling and the Columbia wheel.

McKenney & Waterbury, of 181 Franklin street, corner of Congress, Boston, manufacturers of gas, oil and electric fixtures, have issued a striking calendar. The central figure is a woman with torch and the legend is: "We light the world."

Mr. W. A. Rosenbaum, the well known patent attorney and electrical expert, Times Building, New York City, has issued an exceedingly pretty calendar, with a peaceful rural scene, entitled "A Cool Retreat."

A New Zimdars & Hunt Automatic Motor Starter.



In the accompanying illustration is shown a new and improved automatic motor starter, which is being introduced by Zimdars & Hunt, 127 Fifth avenue, New York. In this device they believe they have an article which is free from the many sources of trouble so common in apparatus of this class It is operated entirely by gravity, no springs or solenoids being employed. The various operations required to properly start a motor are accomplished by the force of falling weights acting through the movements of a number of levers. The time taken to start a motor can be varied by regulating screws, specially provided for the purpose, on the pivoted air dash pot. This device is entirely automatic in its action, the rate of starting being beyond the control of the operator when once the operating arm has been thrown. Among the advantages claimed for this device are the following: Double pole, double break, main knife switch; knife form of rheostat contacts; absence of springs and solenoids; automatic magnetic release; properly proportioned contact faces and current carrying sections; improved form of pivoted air dash pot; accurate adjustment in all parts, and absolute reliability in action. This device shows evidence of very careful designing, which, supplemented by the high grade of workmanship employed on it, should recommend it to those desiring to start their motors from any distant point.

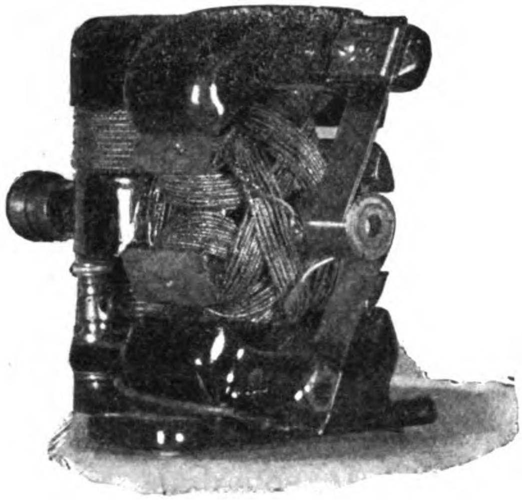
Anchor Electric Company.

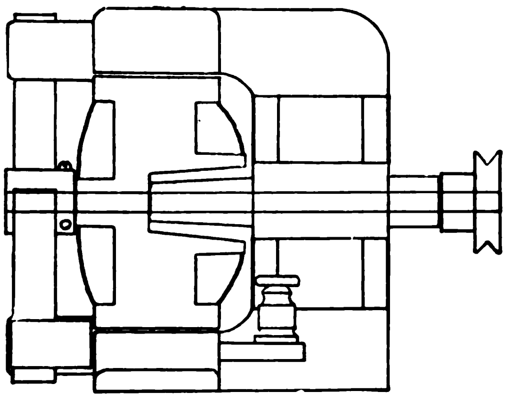
At the regular annual meeting of the Anchor Electric Co., 71 Federal street, Boston, it was voted to increase the capital stock to $100,000. Officers were elected as follows: Norman Marshall, G. O. Proctor, G. H. Proctor, Arthur Howland, directors. G. O. Proctor was elected president; G. H. Proctor, vice-president; Norman Marshall, treasurer; Arthur Howland, secretary. The steadily increasing demand for the Anchor specialties has severely taxed the manufacturing facilities of this well known company, and it has been absolutely necessary to find some way to increase their capacity.

The Kent Battery Motor.

THE Kent Electric Manufacturing Co., of 27 Hermon street, Worcester, Mass., are bringing out a new style of motor designed specially for battery work, and which seems destined to become popular owing to its low cost, efficiency, convenience and durable design.

As will be seen in the accompanying engraving, it differs in several essential points from other battery motors. It has but one bearing, three inches long, reaching nearly through the armature. Thus the shaft is unable to get out of alignment. There is no bearing on the commutator end, thus avoiding the





FIGS. 1 AND 2.—KENT BATTERY MOTOR.

danger of covering the commutator with oil and insulating it from the brushes. The armature is of the drum type, 2½ inches in diameter by 1¼ inches long, and all the iron in the machine is used to advantage for efficiency. It is finished in black enamel with nickel trimmings and rubber cushions are set in the base. The machine may be fastened down by means of two screw holes conveniently located.

The binding posts are placed on each side of the field coil and are entirely out of the way. The pulley is made of cast iron, and is fastened to the shaft by means of a set screw.

The motor is wound for a normal current of six volts, but can be run on from 1 to 12 volts, the power, of course, varying with the voltage. It may be used for any light work requiring less power than a sewing machine. This machine is also wound to be run on a 110-volt incandescent system in series with a lamp.

The "Ideal Circuit Breakers."

A NEW and novel circuit breaker has been put on the market by the Ideal Electric Corporation, of New York. The apparatus is somewhat different from anything yet offered to the public. By referring to the cuts it will be noticed that the movements of the blades, or contact bars, are vertical, having a reciprocating motion up and down. The illustration shows a double pole type, each pole working independently of the other, so that when an overload or short circuit might occur, both blades drop simultaneously. After closing one side of the switch, and the overload or short circuit still existing, in attempting to close the other side, the side already closed will instantly and automatically open. Owing to this arrangement it is practically impossible to close the circuit breaker as long as an abnormal amount of current is passing. The most commanding feature of this switch is that at no time

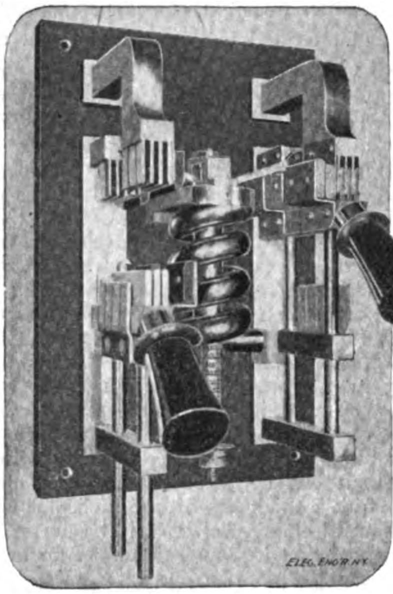


FIG. 1.—"IDEAL" CIRCUIT BREAKER.

during the entire action of opening or closing does it protrude six inches from the face of the switchboard, thereby avoiding the danger so common of striking the operator and injuring him. It is claimed to be the only circuit breaker that a man of ordinary strength can close with rapidity and ease up to 5,000 amperes capacity. All conducting parts are made of hard drawn copper. All parts not made of copper are heavily copper plated, and the entire switch is highly polished and lacquered. It is self-contained and is thereby easily mounted on a switchboard. Only five holes are required to drill for a double pole breaker and no lining up is necessary, as all contact parts are mounted on one copper base, making it impossible to get out of line. Fig. 2 shows a template and all the drilling necessary for a 500 ampere breaker, which avoids the sticking that has compelled the use of heavy springs to throw the blades out of the contact clips. There is only one small compression spring used to operate the Ideal Circuit Breakers, gravity

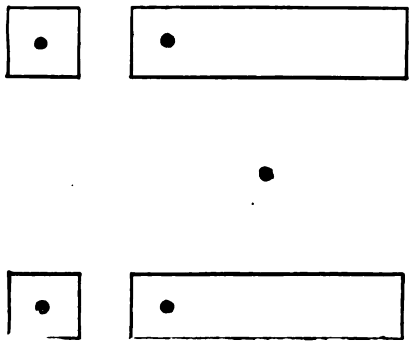


FIG. 2.—TEMPLATE FOR "IDEAL" CIRCUIT BREAKERS.

doing the rest. They are also provided with an evenly divided scale and can be adjusted at from 40 per cent. underload to 50 per cent. overload. Fig. 1 shows a complete double pole circuit breaker; Fig. 2 the template for it. Only three holes need be drilled in the switchboard to mount the breaker. With the Ideal Independent Circuit Breaker no auxiliary switch is necessary, owing to the independent action.

THE DIAMOND ELECTRIC CO., Chicago, Ill., have recently made some important changes in their alternating current meter, and have brought out a new case for their well known transformers. They now are in a position to furnish either the ventilated or the oil type.

Apparatus of the Iron Clad Rheostat Co.

The increase in demand for thoroughly reliable apparatus in the electrical trades has resulted in the development of many concerns who confine themselves exclusivly to certain specialties, and are therefore naturally able to become leaders in their respective lines. The question of proper rheostat control for the fields of dynamos and for the starting and regulating of motors as well as resistances for cauteries, dental lathes and many other applications of the electrical industry has always been considered of special importance to electrical engineers, and builders and users of electrical machinery. Recognizing this principle, the Iron Clad Rheostat Company was formed in the spring of 1895 with the intention of providing the electrical fraternity with the best that could be produced in the rheostat line. Thousands of rheostats, which have given universal satisfaction have been manufactured by them since that time, and an entire reorganization of the manufacturing as well as the business departments of the company now gives them exceptional facilities for prompt shipment of orders, whether of a standard or special nature.

To illustrate in how small a space a 1 h. p. 110-volt motor starter can now be built, it is only necessary to point out that recent exhaustive experiments made by the Iron Clad Rheostat Company have proved conclusively that with their form of construction, it can be placed in an iron clad box five inches square, with a thickness of one inch. This starter was submitted to several eminent electrical engineers, and a result of their test proved that it would stand the normal rated current through the entire rheostat for a period approximately of from 12 to 15 times the rated time limit for which it was designed. The duration of the test covered a period of one hour, and the rheostat was then subjected to double its full rated capacity on one step for four times the rated time limit during which the entire rheostat should be used in circuit. The machine was then subjected to a 1,500-volt alternating e. m. f. between the resistance wire and the iron case without developing any defect in the insulation, which is a remarkable showing for a 110-volt rheostat made without any pretensions as to extra insulation, etc.

The Iron Clad Rheostat Company have recently standardized an entire new line of starters similar to the one described above, and will be pleased to furnish prices, give information, etc., to anybody interested. Their sales are constantly on the increase, and they announce their intention to become the leading builders of rheostats in the United States.

Important Change in the Law as to Foreign Patents.

HOWSON & HOWSON, the patent lawyers, Potter Building, New York City, have issued the following information as to the effect of recent amendments on the same patents when taken out here and abroad:

We beg to call your attention to certain important amendments of the United States Patent Laws, which will go into effect January 1, 1898, under an act of Congress of March 3, 1897:

1. A radical change is made in Section 4887 of the Revised Statutes, affecting the interests of those taking out, or desiring to take out, foreign patents. The section, as revised, reads as follows (the new parts being printed in italics):

"Sec. 4887. No person *otherwise entitled thereto* shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented by the inventor or his legal representatives or assigns in a foreign country, unless the application for said foreign patent was filed more than seven months prior to the filing of the application in this country, in which case no patent shall be granted in this country."

It will be seen that the long standing requirement that "every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent" will be abolished, so that all patents granted under the new law will run for the full term of 17 years. Furthermore, under the new law, an inventor can apply for his foreign patents without waiting for the allowance of his United States application, or arranging for the issuance of his United States patent. In fact, he can file his foreign applications simultaneously with, or even before the filing of his American application. On the other hand, there has been added a limitation, whose practical effect will be to cause a foreign patentee to forfeit his right to a United States patent, unless he shall file his American application within seven months after the filing of his foreign application.

2. A new defence can be set up to an action for infringement of a patent granted under the new law, namely: "That it (the invention) has been patented or described in some printed publication * * * * more than two years prior to his application for patent therefor." Such two years' prior publication or patenting of an invention will bar the grant of a valid patent for the invention under the new law. (Sec. 4886 and Sec. 4920, R. S.)

3. Under the law as amended, the time within which an applicant for a patent is required to proceed with his application in the Patent Office is reduced from two years to one year after any official action thereon. (Sec. 4894, R. S.)

NOTE.—The act provides that the above-mentioned amendments "shall not apply to any patent granted prior to January 1, 1898, nor to any application filed prior to said date, nor to any patent granted on such an application."

4. The act of March 3, 1897, also put in force a statute of limitation, as follows:

"But in any suit or action brought for the infringement of any patent there shall be no recovery of profits or damages for any infringement committed more than six years before the filing of the bill of complaint or the issuing of the writ in such suit or action, and this provision shall apply to existing causes of action." (Sec. 4921, R. S.)

An Expert Diagnosis of Recent Trade Conditions.

Mr. John A. Walker, vice-president of the Joseph Dixon Crucible Co., has the following to say about business: In 1893 it was a case of business paralysis, in 1894 we had a year of debility, in 1895 the patient partially revived, in 1896 came a relapse, but in 1897 came recovery and the patient took up his bed and walked. The great medicine man was dollar wheat and 30-cent corn, plus poor harvests at this exigency abroad. I saw it myself, for in November I visited Indianapolis, Cincinnati, Chicago, Omaha, Denver, Kansas City, Pueblo and St. Louis, and saw everyone up to his eyes in new business. The consumer at last had money once more, and was spending it.

The industrial triumphs of 1897 are important. In this year the business cloud passed away and another era of prosperity, hopefully of long duration, opened. Export trade was larger in the fruits of the harvest, and particularly in manufactured goods, than in the history of the country. Americans are competing in every market. American motors won the order in London. On a bridge in Holland an American firm was the lowest bidder. American steel rails go regularly to China, Japan and India. A movement is on foot to have the English Parliament pass a law changing the stamp on goods not made in England, stamped "Abroad," instead of the name of the country where they are made. This is an effort on the part of the English lawmakers to obscure the origin of these goods.

For the Dixon Company personally we have shared in the general prosperity. The year has been an agreeable one, the future looks rosy to those who have eyes to see. Perhaps the outlook was never more inviting. Never were there so many roads open to wealth to those who know how to find them.

RILEY BROS.—We are pleased to note that Riley Bros., 16 Beekman street, have received a medal for their excellent exhibit at the American Institute Fair. It bears the inscription, "The Medal of Merit Awarded to Riley Bros., for Stereopticons, Slides and Patent Carrier." Messrs. Riley Bros. manufacture stereopticons, magic lanterns and all accessories and will be glad to mail catalogue, with prices, on application.

MONTGOMERY & CO., the celebrated tool dealers, Fulton street, New York, will have ready about February 1 a new 600 page catalogue, pocket edition, which will be sent to any address in the world on receipt of 25 cents.

The International Health Exposition.

The International Health Exposition to take place in New York City April 25 to May 31 in the Grand Central Palace, Lexington avenue, promises to be a great success. Mr. Charles F. Wingate is to be supervising director and the exhibition will enlist the co-operation of the New York Household Economic Association and kindred organizations. Mr. B. E. Greene is actively connected with the enterprise. Mr. Wingate's plans to differentiate this exhibition from the London "Healtheries" and other sanitary shows and to stimulate public interest in health matters by making a display of the best sanitary apparatus in every line, though nothing displayed will be sold at the building during the fair. In its scope the exposition will comprise an educational congress, where the result of years of study given to sanitary problems by recognized leaders and authorities in their several lines of work may be drawn upon. Prison, military, municipal and residence hygiene are to be demonstrated by the most telling object lessons. There will be an actual sweat shop from the East side, with an actual family at work in it. Against this will be shown a model work room from some new manufactory. There will be the insanitary forecastle from some old battleship by the side of the men's quarters from a recently built cruiser. Actual fittings from some county poorhouse of twenty-five years ago will compare with these places under modern supervision. It is proposed to show to the people of New York a cell from the Tombs with dummy figures placed in its narrow bed to show the wretched housing of prisoners. There will also be exhibits of the improvements in hospitals, public schools and lodging houses.

The classification embraces domestic sanitation with 11 groups; municipal hygiene with 20 groups; food products, health resorts and sanitariums; hygienic literature; sanitary organizations and their work; progress of preventive medicine; military and naval hygiene; animal sanitation; industrial hygiene and fire protection. A series of popular lectures will be provided daily during the exposition, in a separate lecture hall. It is intended to offer special facilities for the pupils of public and private schools, as well as teachers, health inspectors and others interested in health matters. Tickets will be sold at nominal rates to employers of labor to distribute them among their workmen. An effort will also be made to interest the residents of the tenement quarters of the city in the exposition. Mr. Greene has already enlisted excellent support by his good work, and is most sanguine of success.

New Standard Open Circuit Battery.

We illustrate in our advertising pages the New Standard, an open circuit battery, which is now finding a ready sale on the market. Mr. Wm. Roche, 259 Greenwich street, New York, is the manufacturer of this dry battery and has for the past eight years been devoted to the making and perfecting of these goods. During this period he has made over 1,250,000 dry cell batteries, the New Standard being his latest production, and the result of long years of continued experience. Among the many merits to recommend this battery, Mr. Roche calls special attention to its durability, its strength, and its recuperating powers, etc., making it one of the most perfect open circuit batteries ever put on the market.

NEW YORK NOTES.

ROBERT A. KEASBEY, 54 Warren street, New York City, is issuing a beautiful calendar with a picture of a basket of strawberries, and they accompany it with some excellent data on house heating. Magnesia sectional coverings bid fair to be in great demand in 1898, so many new plants are going in.

HENRY R. WORTHINGTON, finding their present enormous output of steam pumps inadequate to properly meet the requirements of their trade are making enlargements which will enable them to increase their output over 30 per cent., especially in pumps of 10-inch stroke.

THREE DIPLOMAS OF MERIT to one concern shows pretty well what the judges of the Tennessee Centennial Exposition (held at Nashville last year) think of the Robertson-Thompson indicator, Lippincott planimeter and Eureka packing. James L. Robertson & Sons, 204 Fulton street, New York, entered these three articles, and inform us they were awarded these prizes. They say if engineers and steam users would send for illustrations and descriptions of these goods, it would not only be of interest but profit.

J. P. WILLIAMS, general agent for the "Paragon" fan, 39-41 Cortlandt street, New York City, has issued a very ingenious 1898 calendar. The backboard has a large picture of the "Paragon" motor, with wire guard, in the natural colors, and the months of the year are printed on the yellow blades of a fan, which can be made to revolve. The whole thing is neatly worked out.

GREATER NEW YORK NIGHT was duly celebrated in this borough and Brooklyn in spite of the wretched weather. There was a parade with floats, singing at the City Hall front, fireworks, and as the New Year chimed a fine display of electric lighting. The show was engineered by the New York Journal. A fine illumination was also given specially on the New York World dome.

MR. W. J. CLARKE, needing facilities for manufacturing, has moved from the office building 120 Liberty street, to the Lexington Building, East 25th street, between Third and Lexington avenues, where there is ample power obtainable for such purposes. Mr. Clarke will continue to handle lamps, etc., while the U. S. Electrical Supply Co. will bring out such novelties as Marconi wireless telegraph, X-ray apparatus, etc.

HERRICK & BURKE.—This well known firm of consulting and designing electrical engineers, of 150 Nassau street, New York City, have given notice that their co-partnership dissolves by limitation. The members of the firm, Messrs. A. B. Herrick and James Burke, will continue to devote themselves individually to the practice of electrical engineering, and their address will be the same as hitherto for both of them.

MR. J. W. GODFREY, with Messrs. Harrington and Olsen, his associates in the handling of the Habirshaw wires and cables at 15 Cortlandt street, celebrated New Year's Eve as usual with a luncheon from 2 until 6 p. m., at those headquarters. It was crowded all the time by an enthusiastic and jolly party of electrical folk, and the afternoon went off most agreeably.

J. P. WILLIAMS, 39 Cortlandt street, New York, is meeting with the same brilliant success on "Paragon" power motors as was experienced last summer with his Paragon fans. The power motors are built in sizes 1-12 to 1 h. p.; are excellently designed and constructed, and fill the bill thoroughly for all work intended. We are informed that orders are coming in from all directions for "Paragon" power motors, as well as orders for special small motors for special uses. Prices, estimates, etc., will be promptly furnished to any concern interested in the purchase of these goods.

BURHORN & GRANGER, 136 Liberty street, have issued a neat combination calendar and thermometer, with mounting in red and gold.

AMERICAN ELECTRICAL & MAINTENANCE CO., A. K. Warren, president, and G. Stanmore, general manager, with main offices at 451-3 Greenwich street, New York, have made a most important arrangement with the New York Edison Co. to do all their motor inspection and repair work. Details are given in our advertising pages. The company have splendidly equipped shops on Desbrosses street, and will be glad to show it to visitors, give information or receive inquiries.

AMERICAN STOKER CO., now located in the Garfield Building, Court street, Brooklyn, are now pushing their excellent device with much vigor and success. It has been winning a fine record for prevention of smoke, higher fuel efficiency, economy of labor, absence of repairs, harmony of practice with the best theory, greater cleanliness and many other features. The stoker is in good hands and will be one of the conspicuous steam engineering features of 1898.

NEW ENGLAND NOTES

THE RIVERSIDE WORSTED MILL, of Providence, R. I., is making some extensive improvements in its plant. Among them is the rebuilding of the boiler house, which is being constructed so as to have it absolutely fireproof. The walls are of brick, and the roof will have metal supports with a

tile roofing. Contract for furnishing and erecting the ironwork has been given to the Berlin Iron Bridge Co., of East Berlin, Conn.

CLINTON WIRE CLOTH CO., Clinton, Mass., have the call in the electrical trade for wire cloth and perforated metals. The goods are growing more and more in use for dynamos and motors, for protecting the commutator, etc. Also for rheostats and other electrical uses.

THE EDDY ELECTRIC MANUFACTURING CO., of Windsor, Conn., have just completed one of the busiest years in their career of 16 years of successful manufacture of dynamos and motors, which have established for themselves a splendid reputation all over the country. The management of the company is the same to-day as when they commenced, which speaks volumes in favor of Messrs. Newton and Baird, than whom there are no two more popular or better known business men in the electrical trade. The outlook for 1898 is equally good, as they have on hand a large number of important orders and their factory is now, as it has been for the past four months, working overtime to keep up with the demand. The name of Eddy on a dynamo or motor is synonymous with good workmanship and economy of design and current consumption.

MIANUS ELECTRIC CO., Mianus, Conn., report an unusually large mail order business in telephones, magneto-bells, telephone parts and electrical supplies. They issue an exhaustive catalogue which will be sent to any address if stamp is enclosed.

ALPHEN'S BELT DRESSING, manufactured by William Alphen, Gloucester, Mass., is reported as giving excellent satisfaction in the many places it is now being used.

THE WALLACE BARNES ESTATE, Bristol, Conn., manufacturers of small springs of every description, have closed a most prosperous year and report that prospects for 1898 are excellent for an increased business. This concern has for years been headquarters for small springs, flat or round wire, steel or brass. The W. B. Estate keep constantly in stock a complete assortment of high-grade cold rolled steel ranging from .003 to .049 in thickness. They temper springs at short notice, make ribbon steel to order and enamel and plate springs. The Wallace Barnes Estate solicits samples and will be pleased to make quotations.

F. R. HARRIS, 35 Benedict street, Waterbury, Conn., reports his factory busy with orders which are coming in from all directions. Mr. Harris has long been known as a manufacturer of the best quality spring and electric wire, also fine brass, copper, German silver and phosphor bronze wire. He makes a special alloy wire drawn to order. Correspondence is solicited.

STANLEY INSTRUMENT CO. has been formed at Great Barrington, Mass., with a capital of $75,000. The directors are W. Stanley, C. E. Yerkes, C. R. Huntley, W. H. Brown, P. A. Russell, J. L. Dodge, F. H. Wright, J. B. Beebe, and F. Darlington. For the present the company will build its apparatus in the Stanley shops at Pittsfield. The officers are Frank H. Wright, president; Wm. Stanley, vice-president and engineer, and F. Darlington, manager. A separate factory for the construction of electrical instruments is in contemplation later on.

MESSRS. P. M. REYNOLDS, treasurer, and H. C. Hawks, president, have sold out their interests in the Anchor Electric Co., of Boston. Mr. Reynolds informs us that he has established himself at 63 Equitable Building, that city.

BILLINGS & SPENCER, Hartford, Conn., have recently built for their own use the biggest drop hammer in the world, standing nearly 22 feet high, and the hammer weighing 1½ tons. It is anchored in a solid bed of stone and concrete. The base weighs 90,000 pounds. It is useful for making such articles as heavy sprocket wheels, and is intended to do with one or two blows work that has hitherto taken repeated beats with lighter hammers.

WESTERN NOTES

K. McLENNAN & CO., Marquette Building, Chicago, write as follows: The year with us was an epoch in itself. It marked the change of Gale's commutator compound from a specialty to a staple article; from an article used by a few plants to one of general use, until at the close of the year it is in regular use by nearly every power plant and central station in the United States and Canada, and to be found for sale in every supply house. In the past year we have established agencies in Sweden, Norway, England, France, Germany, Italy and Japan. The name of Gale is now known to every user of a dynamo or motor. Our expectation for the future is to gather in the few power plants which are not now using our compound.

THE ELECTRIC APPLIANCE CO., Chicago, report that their new issue of General Catalogue No. 12 is now very generally distributed all over the country and is producing very satisfactory results, very few buyers being able to resist the temptation of ordering from such a handsome and useful publication. The Electric Appliance Co. are certainly entitled to all the good that their catalogue may bring them, as its production involved a great amount of work and expense.

PHILADELPHIA NOTES

VALLEE BROS. & CO., 625 Arch street, Philadelphia, have dissolved the old partnership, Garrett A. Vallee and George W. Vallee having purchased the interest of Hiram C. Roberts, the retiring partner. The Messrs. Vallee will continue the business under the familiar style at the old stand and solicit an extension of the favors and patronage already granted them.

PARTRICK, CARTER & WILKINS, of Philadelphia, have issued to their friends their annual New Year souvenir note book, accompanied by a little card of thanks and good wishes. The book is cased in celluloid and has a neat calendar.

ADVERTISERS' HINTS

THE UNITED CORRESPONDENCE SCHOOLS, 154 Fifth avenue, New York, offer special inducements to those enrolling before February 1, 1898.

THE AMERICAN ELECTRIC TELEPHONE CO., Chicago, are offering pay station signs for independent companies at 60 cents each.

FAIRCHILD & SUMNER, 39 Cortlandt street, New York, are the general agents of the Onondaga Dynamo Co., and contract for complete power and lighting equipment.

W. S. HILL ELECTRIC CO., New Bedford, Mass., continue to manufacture and sell their standard switches and switchboards.

THE HART & HEGEMAN MFG. CO., Hartford, Conn., show a great number of their switches of the snap, push-button and flush styles.

HAROLD P. BROWN, 120 Liberty street, New York, publishes some things said by other people regarding his plastic rail-bond and also a table of comparative tests.

THE ELECTRICAL EXCHANGE, 166 South Clinton street, Chicago, advertise electrical apparatus of standard makes which they now have ready for shipment.

J. J. McCABE, 14 Dey street, New York, illustrates his double spindle engine lathe, of which he says: "It is an ideal tool for a repair shop."

RIDGWAY DYNAMO AND ENGINE CO., Ridgway, Pa., show different types of their apparatus and offer to send a handsome catalogue on request.

S. S. WHITE DENTAL MFG. CO., Philadelphia, Pa., advertise the Partz acid gravity battery and refer to its points of merit.

FORT WAYNE ELECTRIC CORP. advertise complete electric equipment for lighting and power.

OTTO GAS ENGINE WORKS, Philadelphia, say they have enjoyed a quarter century of uninterrupted success and have received over 250 medals and diplomas.

RUSSELL ELECTRIC MFG. CO., Providence, R. I., advertise mast arms, hoods and cut-outs.

THE WHEELER REFLECTOR CO., Boston, picture an eclipse of the moon by light from Wheeler reflectors.

THE GOLD STREET CAR HEATING CO., Frankfort and Cliff streets, New York, advertise electric heaters of every description; also the Gold improved sealed jet accelerator system of hot water circulation.

JNO. A. ROEBLING'S SONS CO., Trenton, N. J., say the Columbia rail bond saves coal.

PRATT & WHITNEY CO., Hartford, Conn., advertise milling machines, with hand lever movements in three sizes and with power feed mechanism of 19 styles.

THE BRUSH ELECTRIC CO., Cleveland, O., contrast their apparatus of twenty years ago with their high grade apparatus of to-day.

THE EDDY ELECTRIC MFG. CO., Windsor, Conn., say you make no mistake when you buy the Eddy dynamos and motors, as they are the result of sixteen years manufacturing experience under one management.

CHAS. BESELER'S SON, 218 Centre street, New York, manufactures every accessory for stereopticon work and will be pleased to mail catalogues and circulars to any one interested.

S. MORGAN SMITH, York, Pa., will furnish estimates for complete water power plants and guarantee results.

THE SHELBY ELECTRIC CO., Shelby, O., have a very large "ad." on 220-volt lamps.

THE FUEL ECONOMIZER CO., Matteawan, N. Y., illustrate a 4,000 h. p. plant of economizers at Detroit, Mich., and say their economizers are applied to all types of boilers in the representative electrical plants of the world.

THE GLOBE GAS LIGHT CO., 77 Union street, Boston, Mass., recommend the Globe blow torch for soldering electric wires and other purposes where an intense heat is desired.

WM. ROCHE, 259 Greenwich street, New York, says that a test of the new "Standard" dry battery is sufficient to convince the user that it is of the highest grade.

THE AMERICAN ELECTRICAL MAINTENANCE CO., 451 Greenwich street., New York, publish a fac-simile of a letter sent out by the New York Edison Co., endorsing their methods of inspection and maintenance.

THE SIEMENS & HALSKE ELECTRIC CO., Chicago, illustrate a 500 k. w. Siemens & Halske generator.

H. B. COHO & CO., St. Paul Building, New York, suggest that they be given a trial on switchboards, panel boards and repair work.

McINTOSH, SEYMOUR CO., Auburn, N. Y., advertise engines embodying the best materials and workmanship.

THE KEYSTONE ELECTRIC CO., Erie, Pa., advertise multipolar generators and motors tested in accordance with the most exacting specifications at full and overload, and furnish a report of test with each machine.

THE SAFETY INSULATED WIRE AND CABLE CO., 225 West 28th street, New York, mention six large street railway contracts for lead-encased safety cables which that company has taken.

THE AMERICAN STOKER CO., Dayton, O., have moved their offices to Brooklyn, N. Y. They publish some first-class users' endorsements of the "American" stoker.

THE WALKER CO. mention some advantageous characteristics of their alternators and rotary transformers.

THE PARTRICK & CARTER CO., Philadelphia, have been succeeded by Partrick, Carter and Wilkins.

JAMES LEFFEL & CO., Springfield, O., present some tests on the "Samson" turbine wheels, which should prove a strong argument for their selection.

THE EDISON DECORATIVE AND MINIATURE LAMP DEPT., of the General Electric Co., Harrison, N. J., are headquarters for candelabra, decorative and miniature lamps and X-ray apparatus, and also for sockets and shades.

THE A. B. SEE MFG. CO., Brooklyn, N. Y., simply present a cut of a direct connected electric elevator.

SCHIFF, JORDAN & CO., 232 Greenwich street, New York, have been compelled to increase their manufacturing facilities and have acquired control of the works of Julius Fuchs, Nuernberg, Germany. The products of that well known factory will in the future bear the "Ship" trade mark.

THE CENTRAL ELECTRIC CO., Chicago, are optimistic in their outlook for 1898.

DIAMOND ELECTRIC CO., Chicago, Ill., advertise wattmeters and transformers.

N. W. HENLEY & CO., Nassau street, New York, set forth the merits of some works on electricity.

THE AMERICAN ELECTRICAL HEATER CO., 197 River street, Detroit, Mich., illustrate an electric sadiron, which is but one of the many specialties they manufacture in the heating line.

FRANKLIN H. KALBFLEISH CO., 54 Maiden Lane, New York, make a specialty of battery solutions for telephone work and acids for storage batteries.

E. J. WARING, 136 Liberty street, New York, cites the advantages of the "daylight" electric desk lamp. A large stock is always carried to facilitate promptness in making shipments.

EDWARDS & CO., 144th street and Fourth avenue, New York, advertise interval strike, loud ringing, vibrating bells for schools, fire alarms, street crossings, etc.

ZIMDARS & HUNT, manufacturers of electric light and power specialties, 127 Fifth avenue, New York, advertise their high grade knife switches, switchboards and panel boards and their new improved automatic switches and automatic motor starters. This concern have recently installed a lot of new machinery, which, in addition to the old, enables them to keep up with their rapidly increasing business and to maintain the enviable reputation they have acquired for putting out none but the highest grades of apparatus.

WM. E. KLINE & CO., 121 Liberty street, New York, deal in standard and miniature lamps for all purposes and in all styles in voltages of from ½ to 250.

WM. INGLIS IRON AND WIRE WORKS, Detroit, Mich., are introducing a guard for incandescent lamps which has the novel feature of opening so that the lamp may be removed without disturbing the guard.

THE GOUBERT MFG. CO., 16 Church street, New York, have installed 13,500 h. p. of Goubert feed-water heaters in the stations of the Edison Electric Illuminating Co., of Brooklyn. Their new catalogue is now ready for distribution.

THE C. & G. COOPER CO., Mt. Vernon, O., make a specialty of furnishing complete steam plants of the largest capacity.

THE SENTINEL ELECTRIC CO., Wilmington, Del., are the manufacturers of the "Sentinel" service circuit breakers, and combined switch and circuit breakers for every sort of electrical work. They are operative on direct and alternating circuits.

THE ABENDROTH & ROOT MFG. CO., 28 Cliff street, New York, advertise their standard water tube boilers and Root's spiral riveted pipe for high pressures. This pipe is a double galvanized, spiral riveted, flanged pipe and is found especially useful for exhaust steam, exhaust steam heating, pumping and refrigerating work.

THE CROCKER-WHEELER ELECTRIC CO., 39 Cortlandt street, New York, illustrate the largest printing press ever built, driven by one of their motors, as evidence of their efficiency in driving the heaviest kinds of machinery.

THE ECO MAGNETO CLOCK CO., 620 Atlantic avenue, Boston, Mass., call attention to some facts regarding their watchman's clock which are certainly worth considering. Their catalogue may be had on application, describing, among other things, how the clocks are operated without electric batteries.

THE TRIUMPH ELECTRIC CO., Cincinnati, O., refer to a municipal station equipped with their apparatus, in which the incandescents, arcs and power are on the same circuit.

THE KEYSTONE ELECTRICAL INSTRUMENT CO., Ninth street and Montgomery avenue, Philadelphia, advise the public against accepting any "Keystone" instruments unless accompanied by a certificate duly signed, giving the number of the instrument, its range and date of calibration.

L. S. STARRETT CO., Athol, Mass., have just issued a new edition of their catalogue of fine mechanical tools, milling gear and other cutters. A number of new tools are shown and reduced prices of combination squares are given. It is worth asking for.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, note two recent orders for the "chloride accumulators" aggregating 7,100 h. p. hours capacity, and the second battery plant of the Brooklyn Edison Co., with a capacity of 14,000 ampere hours.

THE COLUMBIA INCANDESCENT LAMP CO., St. Louis, Mo., claim their lamps to be the very highest in quality and mention some of the "Columbia's" meritorious features.

THE GRASSELLI CHEMICAL CO., Cleveland, O., advertise sulphuric acid for storage batteries, of superior quality and

free from all impurities. Their New York office is at 63 Wall street.

JAS. BONAR & CO., 121 Carnegie Building, Pittsburg, Pa., state that their sales in Pittsburg feed-water heaters for December amounted to 22,500 h. p.

THE FERRACUTE MACHINE CO., Bridgeton, N. J., recommend their presses, dies and other sheet metal tools as specially adapted to electrical work. Their new catalogue describes over 300 kinds of foot and power presses.

THE PENNSYLVANIA ELECTRIC CO., Marietta, Pa., are the manufacturers of the "Crescent" high grade telephone, which they pronounce strictly up to date. They will be pleased to send descriptive matter to those interested.

THE CAHALL SALES DEPARTMENT, Bank of Commerce Building, Pittsburg, publish a list of repeated orders aggregating over 50,000 h. p.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., advertise "O. K." weather-proof wire as one that will wear, and say it costs no more than wire that does not wear.

HENRY R. WORTHINGTON, New York, has installed over 50 of the Worthington self-cooling condensers, ranging in capacity from 200 to 5,000 h. p. each. He also advertises electric pumps for a large variety of uses.

THE BEATTIE ZINC WORKS CO., Reading, Mass., tell why their battery zincs are more economical than those of other makes and also print two testimonials from well known companies.

THE AMERICAN ENGINE CO., Bound Brook, N. J., refer those contemplating the purchase of engines to a long list of satisfied customers who have installed their direct connected plants.

J. JONES & SON, 67 Cortlandt street, New York, illustrate a variety of electrical supplies as some of the things they manufacture and suggest that it pays to buy first handed.

THE ELWELL-PARKER ELECTRIC CO., Cleveland, O., is prepared to completely equip factories, mills, etc., with the necessary generators, motors and all electrical apparatus for efficiently lighting, and driving all the machinery therein.

THE WARREN ELECTRIC & SPECIALTY CO., Warren, O., the anti-trust incandescent lamp manufacturers, thank their friends for having stood by them and wish them all a prosperous '98.

SHAWMUT FUSE WIRE CO., 93 Federal street, Boston, advertise the Cartwright enclosed air-tight fuse to fit the present 500-volt fuse blocks. They will send prices.

WM. H. BRYAN, M. E., and H. H. HUMPHREY, M. S., Turner Building, St. Louis, Mo., may be consulted on all mechanical and electrical engineering matters.

JAS. L. ROBERTSON & SONS, 204 Fulton street, New York, advertise indicators, of which a detailed description may be seen on another page of this issue.

THE GENERAL INCANDESCENT ARC LIGHT CO. emphasize the simplicity and durability of the Bergmann enclosed arc lamps. Their sales office is at 11 Broadway, New York.

WM. E. QUIMBY, 122 Liberty street, New York, make a specialty of direct-connected electric pumps for water works and elevators. His illustrated catalogue may be obtained.

THE BRODIE ELECTRIC CO., Manchester, N. H., call attention to the "Brodie" single-pole primary switch and cut-out for high tension currents for use with transformers and in general outside construction work. It is claimed that it cannot possibly short circuit and is easily put up and wired.

OTIS BROS. & CO., New York, say their elevators embody all the most up-to-date improvements.

THE ROLLINS ENGINE CO., Nashua, N. H., say that the highest economy, absolutely perfect regulation and noiseless operation are characteristics of their engines.

THEO. AUDEL & CO., 63 Fifth avenue, New York, advertise Hawkins' New Catechism of Electricity and present some very convincing testimonials regarding its excellence.

THE STANDARD THERMOMETER & ELECTRIC CO., Peabody, Mass., say the Upton enclosed arc lamp for alternating current is perfectly noiseless, produces steady light, is simple in construction and economical in operation.

THE STAR DRY BATTERY CO., 143 8th street, New York, advertise their batteries and claim they differ in construction from and are superior to all other dry batteries now made.

WHITMAN & COUCH, 196 Summer street, Boston Mass., advertise "the best telephone in the market," and suggest a trial order as a sure means of being convinced.

THE LEWIS TOOL CO., 44 Barclay street, New York, offer something specially good in vises and guarantee every one.

THE C & C ELECTRIC CO., 143 Liberty street, New York, manufacture all the different types of direct current dynamos and motors required in the most approved and exacting practice, of the highest attainable efficiencies and the most substantial construction.

W. F. & JOHN BARNES CO., 28 Ruby street, Rockford, Ill., publish the new prices on different styles of their lathes.

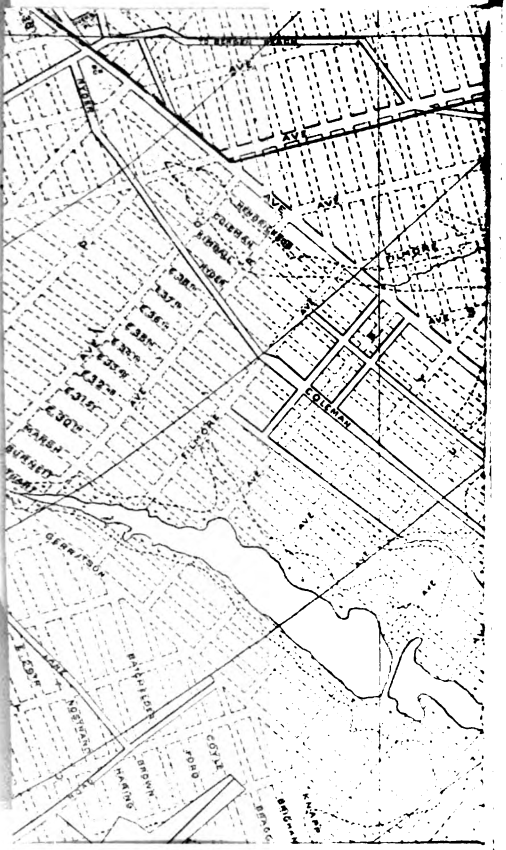
I. P. FRINK, 551 Pearl street, New York, refers to his success of the last forty years in the distribution of light.

THE NEWTON APPLIANCE CO., 120 Liberty street, New York, advertise the "Star" flush switch. Supply houses carry them.

THE CENTRAL TELEPHONE & ELECTRIC CO., 1123 Pine street, St. Louis, illustrate a few of their instruments, of which there are others, and which they say are all winners.

CONTENTS.

Department News Items will be found in advertising pages.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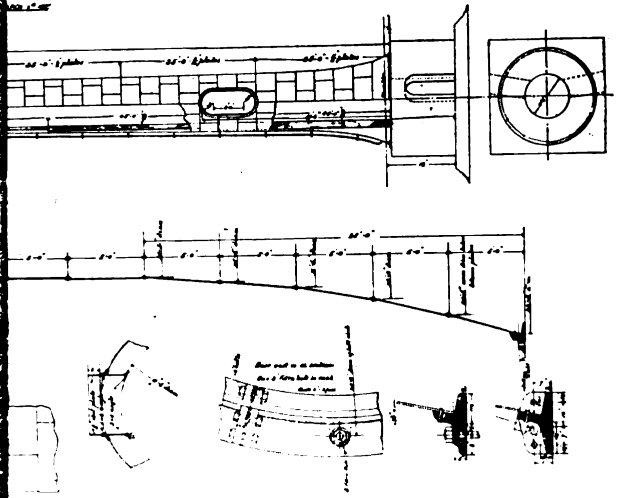

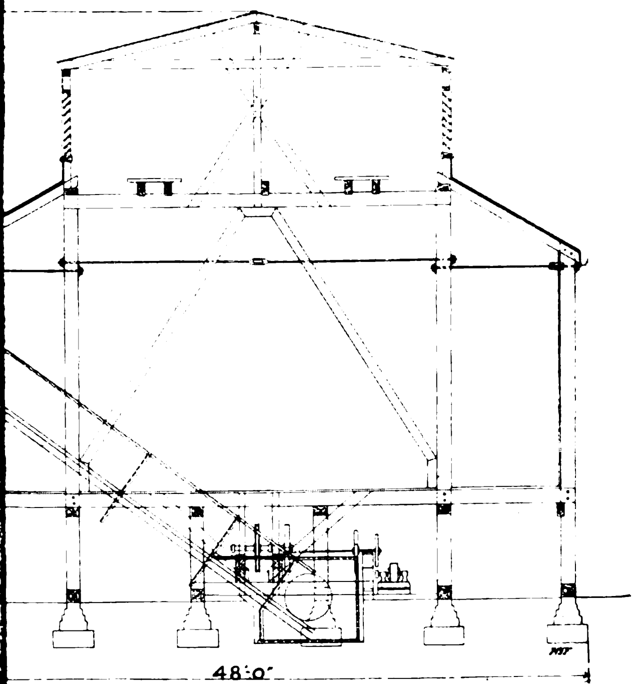

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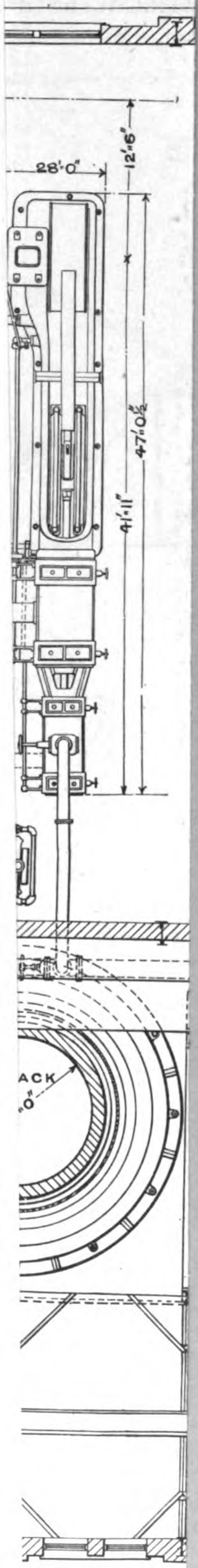

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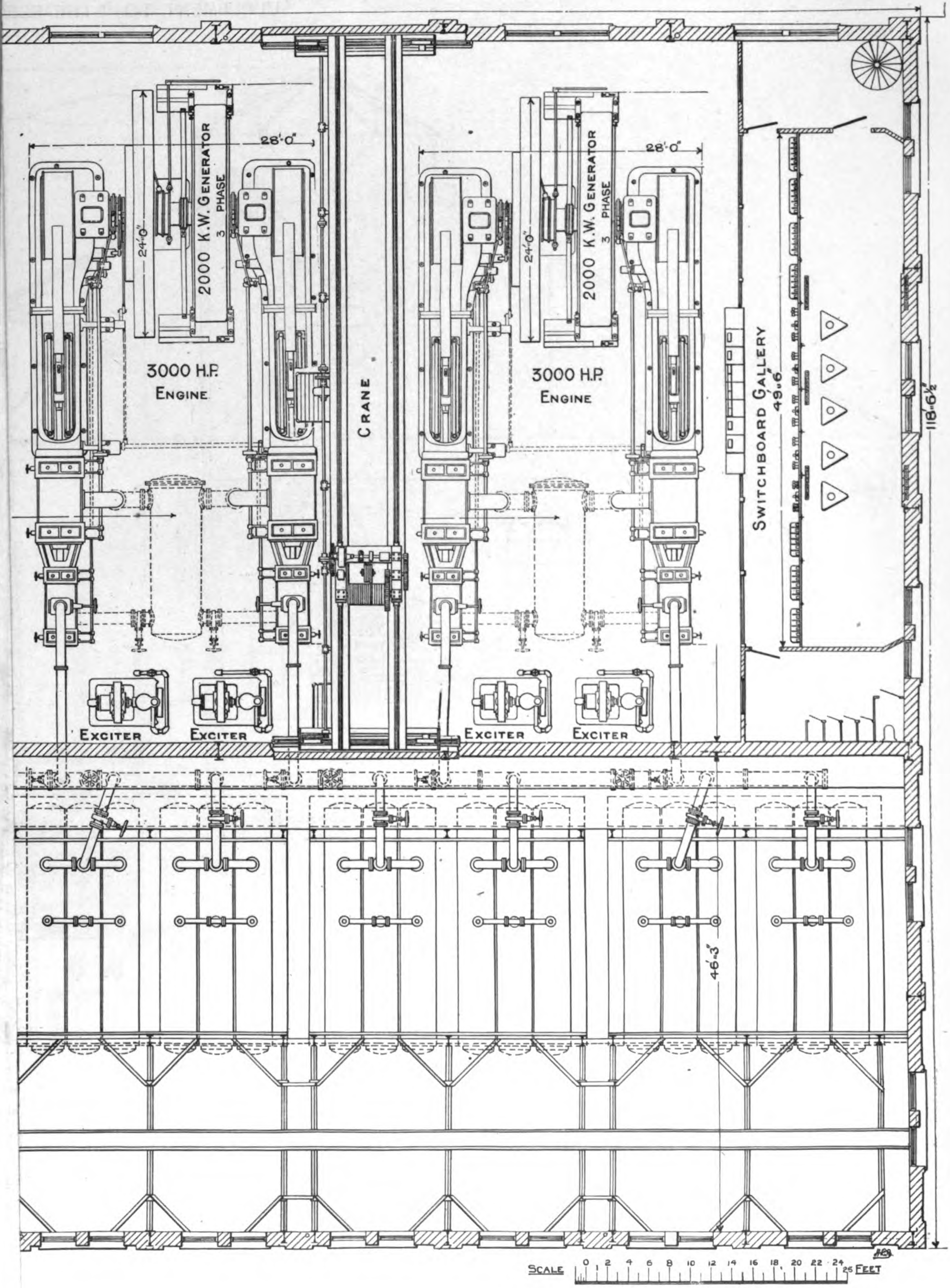


YN.—PLAN OF DYNAMO, ENGINE AND BOILER ROOMS.

The Electrical Engineer.

Vol. XXV. JANUARY 13, 1898. No. 506.

ELECTRIC LIGHTING

Load Factor System of Charging for Electrical Energy.

BY W. S. BARSTOW.

(General Sup't Brooklyn Edison Co.)

THE object of this paper is to call attention to a system of charging for electrical energy (independent of the uses to which it is put) which, while affording a uniform tariff to all customers, will tend to improve the operating load factor of a station and thus gradually reduce the cost of manufacture, which reduction could be followed by a reduction in charges to the customer. It aims to accomplish—

1st. The introduction of a simple tariff, easily understood and appreciated by the public.

2d. A uniform charge to all customers, so based as to apportion to each a just share of the expenses of manufacture.

3d. A gradual improvement of the operating conditions of a station, and consequent gradual reduction in the expenses per unit of energy.

The fixed expenses, herein mentioned, include: Taxes, commissions, executive, engineering and general office expenses; stationery, advertising, legal, etc.; interest on bonds, dividends and surplus, one-half depreciation charges.

The operating expenses, herein mentioned, include: Fuel, oil and waste, labor in station, meter expenses, removal of ashes, street conductors, R. & R.; engines, boilers and piping, R. & R.; house wiring, R. & R.; electrical apparatus, R. & R.; station, R. & R.; one-half depreciation charges.

The sum of these expenses, as mentioned below, forms the total expense, independent of the purpose for which the energy is used. Should the energy be used for incandescent lighting and the company attend to the incandescent repairs and renewals, this item should be added to the final result. Should the energy be used for arc lighting, and the company attend to the arc repairs and renewals, this item should be added to the final result.

EXPLANATION OF THE SYSTEM.

In presenting this method of charging for current, independent of the use to which it is put, the actual existing conditions of a central station company have been closely followed, and to them has been applied a method, which, if adopted, will tend to a continued improvement of such conditions, thereby gradually, without interfering materially with the present rate of earnings, reducing the cost of service to the customer.

The cost of current is made up of two items: Operating expenses, or those usual operating charges which would cease were the operating suddenly stopped. Fixed expenses, or those fixed charges which would continue should the operating be suddenly stopped; in these fixed expenses are included dividends, interest on bonds (both of which, if not paid, would depreciate the capital invested) and half of the depreciation charges, the repairs and renewals being included under operating.

The best conditions of low cost in the generating of energy would be obtained should it be possible to keep the maximum machinery installed in constant operation at its highest efficiency. Should the company operate its maximum machinery every day in the year, but only one-half of the twenty-four hours of each day, the operating expense per unit would show an increase in cost only on account of mechanical inefficiency of the station, which, as the business grows, becomes less and less, but the total fixed expense remaining the same, the fixed expense per unit of current would be doubled. In other words, the proportion between the average load and the maximum load is the earning factor of the station. It is self-evident to all in looking over a load diagram of a central station, that the cost per unit must vary considerably during the day in accordance with the position as to time such unit occupies in the load diagram. The operation of the station has been, and is to this day, studied by a load diagram made up of the current generated during each of the twenty-four hours. In analyzing the expenses of the company, the matter should be studied in the same way, as the expenses of the station are governed by the same conditions as its operation.

In a proper tariff the customer would be charged the operating expenses necessary to produce the unit of current required and a proportion of fixed expenses. In other words, should two customers use the same machinery at different times during a day of twenty-four hours, the corresponding fixed expense on such machinery should be divided between the two, each being charged in addition a common operating cost per unit. If the same machinery is used by three parties they should each stand one-third of these fixed expenses. Thus, each customer jointly pays an equal operating expense and a share of the fixed expense in proportion to the number of hours he uses his machinery in the station.

To be strictly accurate, each day's output of a company should have its corresponding diagram of cost, which will vary with the load factor of that day. As it would require too much space here to do this, there has been taken the average daily output of a company, the maximum of which curve

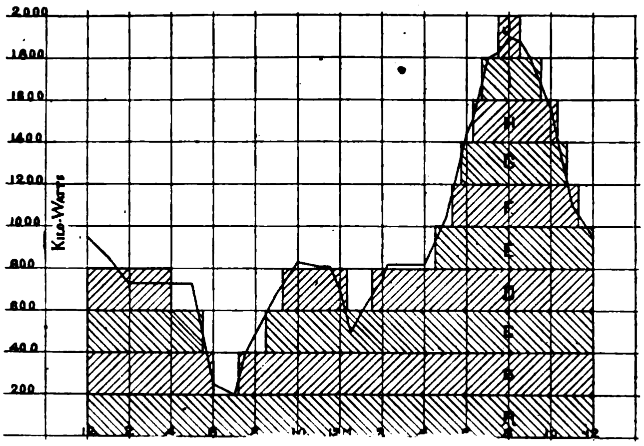


FIG. 1.—AVERAGE LOAD CURVE.

is made up of the average maximums of the year, the load factor of the curve being the average load factor of the station's output for the year. The contents of this diagram (Fig. 1) then, if multiplied by 365, should give us the total yearly output of the station, the maximum showing the average maximum amount of machinery in actual use. For this one average daily diagram of the year might be substituted two average diagrams, one for the six summer months of the year and the other for the six winter months, but, as has been before stated, the number of diagrams and the manner in which they are averaged can be best judged by each station's conditions. And now let us take this average load curve and from it make out a corresponding cost curve; we can then appreciate the variation in the cost of a single unit in accordance with its position in the curve.

First. Take the total fixed expenses of the company and divide by 365, the result being the fixed expenses per day of twenty-four hours.

Second. Apportion these daily fixed expenses to each unit of machinery operated during the daily load, that is, divide the daily fixed expenses by the maximum load of the curve.

Third. Divide the load diagram (Fig. 1) into blocks, each block having for its height a distance measured by the minimum load of the station, and each block having for its base line a distance equal to the time of stopping and starting the unit for the load it takes care of. The reason for this size of block is in order to obtain one high efficiency unit, or one giving the lowest fixed expense (as a company should operate its minimum load during a twenty-four hour period at its highest efficiency). Designate these blocks by letters A,

B, C, D, etc. In examining the load diagram so blocked out it can be seen that block "A" is made up by the operating of machinery continuously throughout the twenty-four hours. Therefore, the hourly fixed expense of this unit of machinery would be the daily fixed expense (mentioned in Second) divided by 24. In other words, should block "A" be made up of a series of twenty-four maximum loads of one hour's dura-

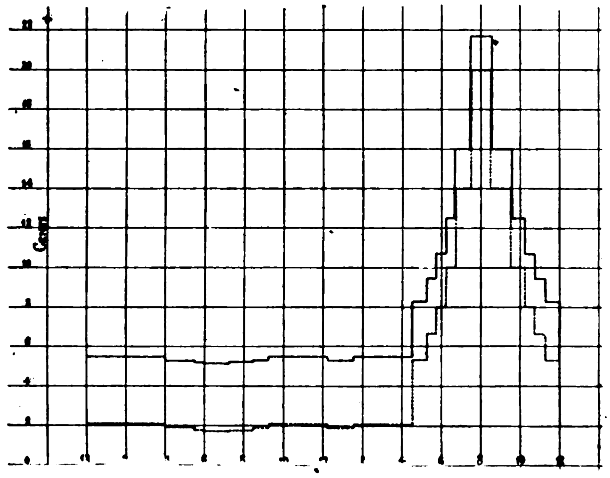


FIG. 2.—AVERAGE EXPENSE CURVE.
Dotted line shows fixed expenses. Solid line shows total expenses.

tion each divided among as many customers, each customer's fixed expense would be one twenty-fourth of the fixed expense of this unit of machinery.

In considering unit "B" we find that it is not operating continuously throughout the twenty-four hours. Therefore, this unit of machinery, during the twenty-three hours that it runs, must stand a larger hourly share of the fixed expenses than if the unit continued throughout the twenty-four hours. In other words, as the earning value of the machinery is measured per hour of unit, "B" would be the total fixed expense of unit "B" divided by twenty-three.

The same rule applies to units, C, D, E, etc., so that:

Fourth. Divide the daily fixed expenses by the hours of operating of each unit and the result will be the hourly fixed expense per unit (depending upon the time such unit is in operation).

If now the hourly fixed expenses, obtained under above directions, for the different portions of the load diagram, are plotted in a manner similar to a load diagram, the resulting curve (dotted line, Fig. 2) will show the fixed expenses per unit throughout the twenty-four hours of the day in accordance with the position that such unit occupies in the load diagram.

In order now to get an operating expense per unit, divide the operating expense of the company by the number of units of current generated throughout the year, making the necessary corrections, due to mechanical efficiency of station at different loads; this correction need not be within twenty-five per cent. of accuracy, because even with this error, the error in total expenses (as the operating expenses are 20 per cent. of the total) would be only 5 per cent., or almost within the accuracy of the customers' meter. If now we add this operating expense per unit to the fixed expense per unit, the result will represent what amount each company should at present pay in order to cover operating and fixed expenses, as mentioned in the first part of this paper.

And now, before proceeding to the practical system best suited to these conditions of expense, let us see what happens as the load factor of the station improves. As the minimum load increases, the next unit working nearer twenty-four hours will cause its expense line to gradually fall to line of lowest expense, until at a load factor of 100 we find the expense per unit throughout the entire day equal to the minimum expense shown in the curve (since all the machinery is operating at its highest efficiency and under the same conditions as in block "A"). The building up of the minimum load or increase of load factor, has the effect of lengthening the time of low rate and also reducing the high rate or reducing the total expense to the customer (Fig. 3), those customers using current only on the maximum load being the last to receive the reduction. Instead of charging customers different rates for current during different hours of the day, as shown by this expense curve, it is proposed to divide the day into two parts instead of one, as it is now done, and during one of these intervals grant a discount, making this net price equivalent to the average low rate, as shown on the expense curve.

To accomplish this end, the Kapp meter device is admirably adapted. This device, in American form, consists of a self-winding clock controlling two dials which are thrown in or out of action at pre-determined times, as shown by expense curve. When used with an Edison meter, it is placed so that the clock controls the shunt circuit of the meter. Thus one meter shunt is continually recording, while the second meter shunt records only at pre-determined times, or the clock switch is so made as to transfer the current from one meter shunt to the other, giving two distinct readings for the different periods of the day. The above readings are, of course, secured without interrupting in any way the main service.

As applied to the mechanical meter, the clock controls, mechanically or electrically, a small clutch, which at pre-determined intervals couples together two separate registering trains. Thus at all times one train is continually recording, and at the desired time the other train is thrown into action, One form of this device is the coupling to the meter shaft first one meter train and then the other, the dials thus recording the current used during the two intervals of the day.

It has been proposed to have the clock introduce into the shunt circuit, at pre-determined times, a resistance which would tend to reduce the speed or rate of recording of the meter, so that the sum of the readings taken by the meter at its normal speed and reduced speed should be recorded on the single dial or single meter bottle. This form of differential meter is open to a very serious objection, as it does not record the current used, and it is almost impossible for a company to make an intelligent contract with a customer with such a device, for at the end of the month there is no way of ascertaining how much current the customer has used at list price, and how much at a discount.

With the Kapp device the form of contract is the same for all customers, the same price being made to all customers on all current used. But a customer using a large quantity of current during the minimum load period of the station, and a small amount during the maximum load of the station, would receive a lower bill than a customer using vice-versa, both customers being on equal basis. This condition of affairs corresponds exactly with the company's expense for the current and cannot but increase the load factor.

Each company must prepare a working load diagram according to the condition of its present tariff, and upon results thus

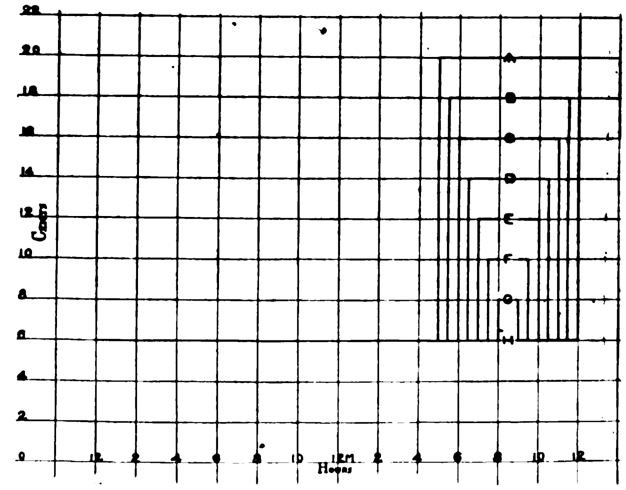


FIG. 3.—TOTAL EXPENSE CURVE.
Effect on total expenses of increase of load factor; i. e., A, load factor, 45 per cent.; B, load factor, 50 per cent.; C, load factor, 55 per cent.; H, load factor, 100 per cent.

obtained, base its net year's charges. In changing over from an old tariff to this new system it will be found, perhaps contrary to expectations, that the net results will be affected but slightly. It will be found that there are many customers whose charges per unit will be increased rather than diminished, and

as it is impracticable to increase these charges, these customers would remain on the old basis until a time when the high rate period would be at such rate and duration that their net bills would be equal to their present net bills, at which time the old contract can then be exchanged for the new one. In this way, by the wish of the customer himself, the system can be gradually changed until all customers are upon an equal basis and form of contract.

The system, thus far, makes no distinction between the large or small customer, each being charged at the same rate. If a company desires to make such distinction, it should be done by granting an extra discount, depending upon the amount of the bill. Thus, throughout the entire system of charging, all customers remain on the same basis.

Sample Contract Clause.—The customer to be charged at a rate of twenty cents (20c.) per kilowatt hour for all electrical energy used between the hours of 5 p. m. and 12 p. m. each day, and to be allowed a discount of 70 per cent. on all electrical energy used during the remaining hours of each day.

CASH DISCOUNTS WILL BE ALLOWED ON

All net bills over $100....................10 per cent.
All net bills over $250....................15 per cent.
All net bills over $500....................20 per cent.

As load factor of plant increases, discount can be made on twenty cents (20c.) and the interval at this rate shortened until the discount becomes equal to discount on remaining hours of the day and the interval becomes zero as will be the case when load factor becomes 100 per cent. Curves in Figs. 1 and 2 should not be confounded; with increase of load factor on Fig. 1 the lowest expenses of Fig. 2 can never be increased.

Multiple Rate Metering.

BY EUSTACE OXLEY.

IT is not probable that "methods of charging for current" is a subject that will now command the same general interest that has heretofore been shown, both in this country and abroad.

The reading public is growing tired of a discussion that has had little result, except the production of a great variety of conflicting opinions. Still, it is hoped that a question of such importance may not be without interest, provided it can be shown that a long step has been taken in the direction of its solution. A new system of applying the double rate method of charging has been employed by a large electric lighting corporation in this country, for some five or six months past. Broadly speaking, the method is well known, but its employment in this instance has been under novel conditions. The marked success which has followed, and the results that have been accomplished in solving problems of much importance to all generating companies, will lend interest to a description of the manner in which these ends have been attained.

A rational and satisfactory system of charging for current must accomplish certain results, all of which are essential, though not in the same degree. Prominent among these are three considerations which cannot well be separated: The first is to reduce the cost of generation, the second to extend the adoption of electric energy for heating, lighting, power and all the uses for which it is so well adapted, and the third to induce all consumers to increase their consumption, economically to themselves and profitably to the generating company. Such a method must have in view the improvement of the load factor of the entire outfit, the mains as well as the generating mechanism.

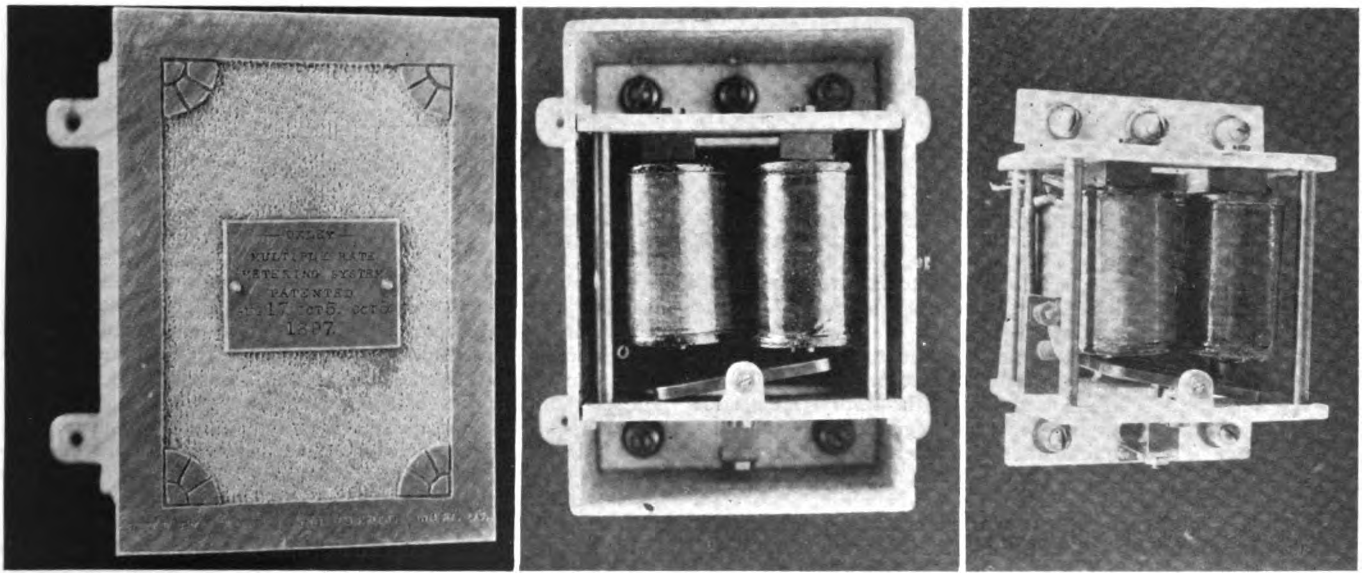
To do this effectively it must hold out strong inducements to all consumers to extend the hours of consumption, and to multiply the purposes for which current is used. It should not discourage an increased demand for current at any hour of the day, but it should not, on the other hand, induce large demands during those hours when the maximum output for lighting occurs. The general aim must be, as Prof. Thomson says, to "smooth out the hills and hollows of the load diagram," and this can only be done properly by bringing the lower parts of the load curve up to the peak as nearly as possible, instead of lowering the peak itself.

Finally, the method must be simple and equitable, to both the company and the consumer. A method that accomplishes all these objects would seem to be as near the ideal as possible. The experience of the past appears to have established a general conviction that the double-rate method, or discounts based upon the time of demand, is best adapted to the main requirements.

It has been widely used in different ways, and is simple and logical. To give consumers a discount, or low rate, during all hours save those in which the peak of the load occurs, and a normal or higher rate during the few hours when the maximum number of lamps will be in use, holds out the strongest inducement to the public to substitute electric energy in place of steam for power, and to employ it for many other purposes.

An increased rate during peak hours does not, in any proper sense, discourage increased demands at that time, and, on the other hand, it does not have any tendency to produce such demands. A reduced rate during the remaining hours, at the lowest figures consistent with the proper interests of the generating company, will act as a powerful inducement to the consumers to use current during those hours.

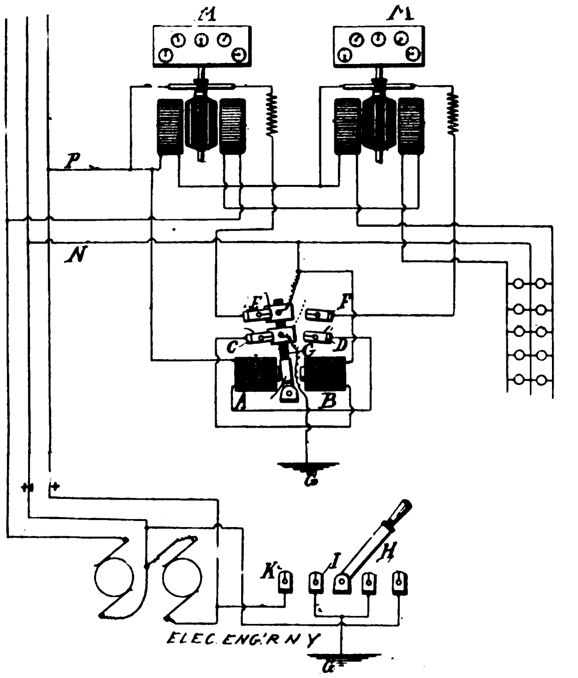
Cooking, heating and many other of the familiar processes of daily life only await the time when their performance by a servant, so safely and cleanly, can be had at a cost which is not prohibitive. The resulting improvement of the load factor, and the increased efficiency of the generating mechanism, will

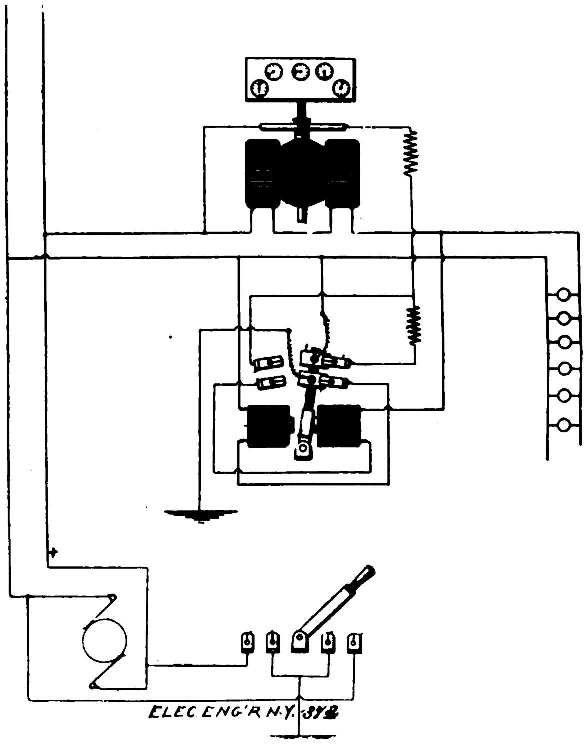


FIGS. 1, 2 AND 3.—THE OXLEY MULTIPLE RATE METER CONTROLLER.

then reduce the cost of production and enable every part of the mechanism to earn its share of the fixed charges. The reduced expenses, and the larger earnings in the extinguishment of the standing charges, will go far toward multiplying the profits of long hours' use, even at largely reduced rates. Moreover, it has been repeatedly demonstrated that such increased demand for long hours, and the resulting improvement in the load factor of the whole outfit, is of itself the means of a great saving in the actual cost of generation.

This matter is too well understood to require any discussion, but as a single example, it may be mentioned that at Brighton, England, it was found that an improvement of 3 per cent. in the load factor had the same effect in reducing the total cost of producing electricity as if the coal bill had been reduced 15 per cent., the charge for coal in this case being $5 per ton. The importance of accomplishing results of this nature has been very generally admitted. The difficulties encountered in the use of a double rate method have been such, however, as to seriously affect its adoption, although a large number of the leading central station managers regard it as the most complete and simple solution of the problem. The objections





FIGS. 4 AND 5.—THE OXLEY MULTIPLE RATE METER CONTROLLING SWITCH AS ARRANGED FOR TWO METERS AND FOR ONE METER.

urged against it seem to have been due to faults in the means by which the method has been practiced, and not to any defects inherent in the method itself.

Among the devices heretofore proposed the best was probably that employing two separate meters, or meter dials, one to register all the current used during the hours when a low rate was charged, and the other to register that used at a higher rate. This required the two meters to act alternately. Their operative alternation was effected by a clock at each point of consumption. The expense of installing such apparatus upon a system of even an average extent, would be large, and would materially increase the fixed charges.

But a more serious objection was found in the great liability of clock gearing to stop, or become wholly unreliable, when used to make and break an electric circuit. While this may be overcome to some extent, by using clock gearing of the best manufacture, the evil cannot be entirely eradicated, and the large increase in cost, due to the price of high grade clock movements, would not be compensated by the removal of the objections against the cheaper grades. The frequent inspections necessary, the numerous removals of clocks for repairs and regulation, and the winding and setting of a large number of such clocks, would evidently require an increase in the number of employés.

As one of the chief objects of a system of charging should be to enable the company to reduce the cost of generation, and lower the rates for current, a method that enlarges the running expenses, is, to that extent, hostile to the very purposes for which it is adopted.

It has been proposed to meter a double rate upon a single meter; the speed of the latter being varied by inserting a resistance in an auxiliary circuit at the central station. The plan was to connect all the meter shunts with a separate wire, run from the station to the points of consumption, and to vary the voltage on this wire, by the insertion of resistance at the central station to regulate the speed of the meters, so that they should register a part only of the current actually used during the hours when a low rate was given. One objection to this method is that the interruption of the auxiliary circuit would cause every meter to stop. A more serious objection however, is that the necessary drop of voltage upon the separate wire would be likely to seriously impair the accuracy of the results obtained.

A single meter, however, can be used in a manner that removes all objection, and gives accurate registration. By the use of the same form of controller, to be described later, a resistance can be inserted in each meter circuit, at the hour when the low rate is to begin, and maintained therein until the end of the low rate period. This resistance is graduated to retard the speed of the meter to a degree representing the ratio the low rate bears to the full rate. When inserted the meter will register only a part of the current that is used. By the insertion of this same resistance at each point of consumption, the provision of an auxiliary circuit is avoided, and no inaccuracy can be produced by a drop in the voltage. This plan has the advantage of economy, by saving the expense of a second meter at each point of consumption. In some instances this saving may be important, and it is of course desirable in all cases. The plan of using two meters, registering alternately, has the merit of simplicity, and is preferred by the average consumer, who can easily understand it and calculate the amount of his indebtedness. The single meters can be connected with the same ease and simplicity as the two separate meters.

The chief difficulty in the way of the double rate method—or, as it is sometimes termed, the differential rate, based upon the time of demand—seems to have been the absence of suitable mechanical appliances by which two meters could be duly controlled, one to meter current at a low rate, and the other at a full rate and in such a manner as to fully protect the company against fraud, secure accuracy, and avoid any material increase in the fixed charges, due to large outlay for apparatus. A description of the apparatus, and the method of

controlling it, as now installed upon the system of the company using it, is as follows:

At each point of consumption is placed a small electro-magnetic controlling switch, shown in the accompanying Figs. 1, 2 and 3. The parts are all enclosed in an aluminum case, 4½ inches in length and 3½ inches in width and depth. The enclosed parts consist of two independent electro-magnets, A and B in the diagram Fig. 4, and a pivoted arm G carrying an armature and knife contacts, and arranged between the electro-magnets. Upon each side of the pivoted arm are two clips, C and D, which clips are connected to the terminals of the windings of the electro-magnets A and B, the connection for each clip being made with the magnet lying on the other side of the pivoted arm. The second terminals of the windings of the magnets are connected (in a three-wire system) to the positive service wire P, and the neutral house wire N.

Two clips, E and F, one on each side of the pivoted arm G, form part of the armature circuits of the two meters M, M. These meters are shown in the diagram as being of the high efficiency type of Thomson wattmeter, and they are connected with the controller at each consumer's premises by a wire led from the middle right-hand binding post, connecting with the shunt or armature circuit, to the right-hand terminal at the top of the controller case. This is the only change made in the normal connections. In Thomson meters of other types, not having the extra binding-post, a small hard rubber block is attached to the wooden back piece, between the binding-posts. On this rubber a narrow strip of brass is mounted, having a small screw at each end, to connect with the terminal of the controller, and with one of the armature connections.

In meters having shunt circuits, such, for example, as the Edison chemical meters, as well as other types, the manner of connecting the controller is practically the same. In some forms of meters, however, as those provided with a series winding only, a modified construction of the controller is used, by which each meter is wholly disconnected, when its period of registration is terminated.

The pivoted arm G carries two knife contacts, one of which is connected to earth, and the other to the neutral house wire. The lower knife, having an earth connection, is struck into one or the other of the two clips, C or D, which connect with the terminals of the two electro-magnets. One of these controllers is placed at each point of consumption.

It will be seen from the diagram, Fig. 4, that by throwing the pivoted arm G to one side, the armature circuit of one meter is opened by the withdrawal of the upper knife, from one of the clips E or F, while the entrance of said knife in the clip on the other side of the pivoted arm completes the armature circuit of the other meter.

The whole system of meters is controlled from the central station, where a small double-throw switch is placed. Two of its clips, H and I, one on each side of the switch arm, have an earth connection. Clip K, on one side is connected to the positive, and the clip on the other side is connected to the neutral of the system. When the arm of the switch is closed or thrown into the clips on one side, the circuit will be from the positive, over the switch-arm and clip I to earth, then at each consumer's station, by the lower knife and the switch arm G, through the clip C, in which the lower knife is lying, thence through the winding of the magnet B, on the other side of the switch-arm G, and then to the neutral house wire and main. The switch arms at all points on the system are by these means thrown simultaneously into the clips, opposite those in which the knives were resting.

At the instant when the lower knife on the controller arm withdraws from the clip in which it rests the circuit of the electro-magnet that produces the movement of the arm is opened at the clip. As the same knife strikes into the corresponding clip on the other side of the controller arm G, it completes at that point the circuit of the magnet which will be energized when the switch at the central station is thrown into the two clips opposite those in which the switch was previously closed.

An indicator is arranged at the central station to show at any moment at which rate current is being metered. It consists of two dials, having suitable words inscribed, to denote the difference—"Day" on one and "Night" on the other dial answers the purpose. The two dials are illuminated by lamps placed behind them, and cut in alternately by the operation of the station switch.

Several things are noticeable in the arrangement described: First, the automatic breaking of the circuit of the electro-magnet, by which the throw of the pivoted arm of the controller is produced, and the completion of the circuit of the other electro-magnet, at the opposite clip, by the same movement of the arm. Every controller upon the system thus cuts itself out automatically, by the simple movement of the pivoted arm G.

Second, the marked simplicity of construction, and arrangement of parts, by which liability to become disordered and tendency to depreciation are reduced to the minimum.

Third, the extremely brief period that current remains on the control circuit, this interval being measured by the time required after one magnet is energized, to enable the knife to draw out of the clip which forms part of the circuit of that magnet.

Finally—and this feature is the most important of all—the control apparatus throughout the entire system is installed and operated electrically from a single point (the central station), without the trouble and expense of providing a wire, or wires, for the control circuit. This is a feature of no small advantage in any case, but where the mains are not laid in subways and where, as in the Edison system, the wires are piped and buried beneath heavy block pavements or asphaltum, the labor and cost of laying a control circuit would be very great.

Upon the lines of the company where the apparatus is installed the mains are in conduits in which two disused pressure wires were found, each No. 16, B. & S. gauge, and partly as a matter of convenience one of these wires was used for the circuit, controlling a number of the earlier installations. With others, two circuit wires were connected, the object being to ascertain if there were advantages in one arrangement, as compared with the other. Repeated trials and continuous use, extending over a period of nearly six months, have shown that the accuracy of control and certainty of operation were the same.

Dispensing, therefore, with wires for the control circuit, the cost of installation is reduced to a point so low that the addition to the fixed charges caused by the complete equipment of a system with the apparatus will be inconsiderable.

The controllers, which practically constitute the entire apparatus, are simple and inexpensive, and are connected and disconnected quickly and with ease. Each controller takes from one-fortieth to one-twentieth of an ampere for its complete operation. The small current and the high resistance of the electro-magnets, which are wound with No. 40 wire, and have 2,000 ohms resistance, or more, render an ordinary resistance, due to a poor ground connection, of no consequence.

The importance of improving the load factor, as the means of reducing the cost of generation, is well established. The necessity of effecting this is evident by the readiness with which many central stations have installed costly acccumulators, which have been thought by some to afford a solution of this problem.

Accumulators are valuable, no doubt. They come to the rescue in the event of a break-down; they steady the load; they can supply a sudden large demand for current which happens during peak hours, and in other respects they are useful adjuncts of a central station. Moreover, they improve the load factor of the generating mechanism, but not the load factor of the feeders and mains.

The latter, which may constitute by far the largest part of the investment in systems of ordinary extent, are not affected economically by the presence, or absence, of accumulators. There are, however, objections to them. They are highly expensive; they suffer a loss in efficiency of 25 per cent.; they depreciate rapidly; they occupy much space in the plant; their upkeep is costly, and they require a large outlay of capital with respect to the output.

On the other hand it has been shown repeatedly what is the advantage of increasing the hours of consumption, and thereby improving the load factor of the entire outfit. It is only by offering effective inducements, which bring about a material extension of the hours of consumption, largely increase the adoption of electric energy for every purpose for which it can be adopted, and enable it to compete with gas and steam, under conditions of practical equality, thus only that the "hills and hollows of the load curve" can be smoothed out, and the actual cost of production reduced to a point that will remove the incentive for maintaining private plants, and

the substitution of gas and incandescent burners in place of the electric light.

In an article by Prof. Marks, of recent publication, a tabulated statement was given, setting forth the results in a given case of increasing the hours of consumption. Among other points shown it was stated that an incandescent lamp of 16 c. p. burned two hours daily cost each year $2.16, and yielded an annual profit of $2.63. If the use be extended to 12 hours daily the yearly cost would be $7.26, and the yearly profit $21.46. Here the improvement of the load factor, due to an extension of the hours of use from two hours to six times that number, multiplied the annual cost by 3.36 and the yearly profit by 8.16.

It is well understood that the standing charges may constitute at least 85 per cent. of the total annual expenses of a generating plant. The remaining 15 per cent., therefore, represents the yearly running expenses, fuel being in most cases the largest single item. A central station, therefore, can double its output without adding to its expense account more than another 15 per cent.

Prof. Thomson, in speaking of the problems that confront central station managers, says that improving the load diagram is apparently of more real importance to them than systems that would double, or even treble the present coal efficiency; by which is meant the percentage of energy value of the fuel, converted into electric energy. It is well known, also, that the condition even arises where a given load, which will improve the load factor, without affecting the maximum load, would be profitable at a rate less than cost, the profit

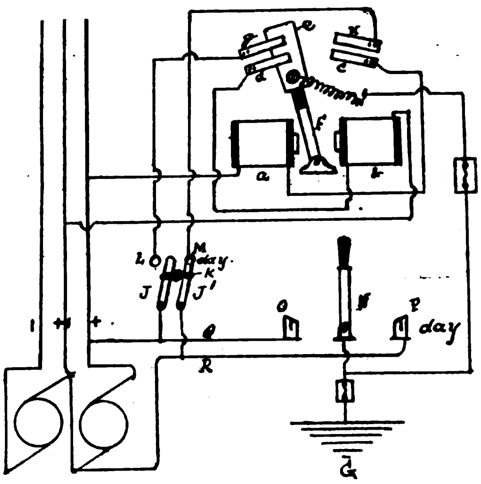


FIG. 6.

being made by the increased efficiency of the whole outfit.

Central station men cannot be misled as to the plain indication for the future. The multiplication of private plants, the increasing frequency with which incandescent gas burners are displacing electric lamps, and the readiness which many gas companies have shown in reducing their charges, all point to the conclusion that a reduction that will permit competition with gas and steam is the only condition upon which the general extension of the use of the electric current can be assured.

One result of the new method adopted has furnished in this connection a gratifying assurance of the benefits to be derived. A large mercantile house, in which lamps are burned all day, to light the basement, had substituted gas in place of the incandescent lamp. Since the introduction of the double-rate method, however, the gas lights have been removed and the electric lamps restored. Both changes were made in the interest of economy.

The duration of the hours of low rate will be fixed by the manager of the central station. The time at which this period begins will be regulated by the time at which the peak hours may be expected and this will be, in a measure, influenced by the season of the year. For instance, in winter the high rate, or full rate period, may begin at 4 o'clock p. m., and continue until, perhaps, 11 or 12 p. m. In summer, when the evenings are shorter, the hour at which the full rate begins and ends will be varied in accordance with the time when the maximum demand upon the generating plant may be expected.

The controlling switch at the central station is placed upon the switchboard at a convenient point. At the hour fixed for the change from one rate to the other the employé throws the switch blade on the switchboard into the clips which form part of the circuit of the electro-magnet that is to operate the pivoted arm of the controller. The switch blade need not remain in the clips more than one or two seconds and in that time every pivoted arm of every controller on the system is withdrawn from the clips in which it rests and thrown into the clips on the other side of the arm. This action, where two meters are used, opens the armature or shunt circuit of the meter by which one rate is registered, and closes the corresponding circuit of the other meter. Thus the former ceases to act at the moment when the latter begins.

If a single meter only is installed at such point of consumption as shown in Fig. 5, the action of the controller is the same, but instead of the alternation last described, the throw of the pivoted arm of the controller simply inserts, or cuts out, a resistance in each meter circuit which varies the registering action to the required degree. The same result can be produced by causing the pivoted arm of each controller to shift the meter circuit from the two outside mains of a balanced system to one outside and the neutral. This varies the voltage in such manner as to produce a registering action of double the speed in one case, as compared with the other.

As it is possible that a temporary ground may accidentally occur on one of the mains, by which the controllers may be operated at the wrong time, a separate controller is mounted on the switchboard and connected in the same manner as the others that are placed at the several points of consumption. Upon the occurrence of a ground this controller will be the first to operate and will attract the attention of the employé at the switchboard, who will, in such an event, operate the main switch and thus restore all the controllers to their proper position. Means, however, have been provided by which this result can be accomplished automatically, and although the apparatus is very simple, its description and illustration will be reserved for a future article.

While writing this article the author's attention has been directed to inquiries concerning several points which it was thought unnecessary to consider in the space at his command. These questions relate, in part, to that form of the system in which a ground circuit is used, and as economic construction will award this form the preference, as it entirely dispenses with a separate metallic control circuit, and thus avoids the expense of tearing up pavements to lay it, it seems essential to point out the only difficulty that has been suggested to the writer, and to describe briefly the very simple means by which this difficulty, which had been anticipated, is entirely removed.

Wherever the ground circuit is used, it is evident that an accidental ground at any point upon the system may operate every controller, and, by prematurely throwing the armature bar over toward the magnet energized by the circuit that is closed through such an accidental ground, the meter registration at every point will, from that moment, be at the wrong rate. Unless this disturbance is corrected without delay, the results may be serious. If the ground occurs during the low rate period the consumers are the sufferers—for a comparatively short period might be enough, where current is used for power, to largely affect the monthly bills. But the generating company, while an involuntary gainer in a monetary sense, may lose even heavily in the diminished confidence of the consumer, and is fortunate if it escapes strong suspicion of having employed dishonest methods.

To effectually guard against all objectionable results possible from such disturbances, by automatically restoring the controllers to the condition that corresponds to the rate the meters are registering, when the ground occurs, a very simple apparatus is placed at the central station, at any convenient point. It is shown in diagram in Fig. 6, and consists of electro-magnets A and B. The first terminal of the magnet A is connected to the positive side of the system and the second terminal carried to a clip C. The terminals of the magnet B are connected to the neutral and to a clip D, lying opposite the clip C. Between these clips is a single knife E, carried by an insulated bar supported by the armature F. Upon the same side with the clip D is a clip G, and opposite it is a similar clip H, so arranged that, when thrown by the electro-magnets, the knife will enter both clips on the side to which it is thrown.

At a convenient point is a switch consisting of two arms, J,

J^1, pivoted at one end, and connected by a pivoted, insulating bar K. Thus, when moved in unison, one arm may be placed on a contact L, and the other removed from a contact M, or vice versa. The small, single-pole, double-throw switch, the arm W being held by a spring out of its clips O and P, is the control switch used at the central station. Its clips are connected to the positive and neutral by wires Q and R respectively.

It will be noticed that the apparatus bears striking resem blance to the controllers. Its construction is varied but slightly, and there is no increased complication. The operation is as follows:

As shown in the diagram, the controllers have brought the day-rate into registration. This has been done by first moving the connected arms J, J^1, to the position shown, and then closing the arm N in the clip P. Upon releasing this arm it is thrown out of the clip, as shown, by a spring or other suitable means. The circuit completed by it has not only operated all the controllers on the system, but has also energized the magnet A and thrown the knife E into the clips G and D.

It will be seen that the controllers were last operated from the neutral side of the system, and therefore, should a ground occur upon either the positive or negative, the magnet B will be energized, drawing the knife E out of the clips in which it lies and into the opposite clips. As it enters these clips the positive is again grounded, and all the controllers are restored to their original position. As the ground is of short continuance, the knife E is automatically restored to the position shown in the diagram. As some of the controllers may be sluggish, it is well to retard the movements of this knife by a dash-pot, or other suitable means, to give time for the complete restoration of all.

An advantage is obtained by winding the controller switches for 200 volts. Not only do they then require less current for their operation, but they are controlled from the central station by grounding either the negative or positive side of the system. A ground on the neutral, therefore, as it results in 100 volts only, does not affect the controllers, such a pressure being insufficient for their action. Thus, disturbances due to accidental grounds upon the neutral, are excluded. Moreover, if a ground occurs on the side from which the controllers were last operated, no disturbance can result. The liability of such disturbance is thus greatly reduced. When they do occur, the results that follow will be instantly corrected, in the manner and by the means decribed.

Greater New York Celebration On New Year's Eve.

AMONGST the features of the celebration on New Year's Eve, at City Hall Park, to signalize the creation of the Greater New York, the electric lighting effects took a leading place. Stimulated by its successes on Election Night, as recorded already in these columns, the New York Morning Journal determined to go even further than at that time in the use of spectacular electrical effects; and it called once more upon J. B. Colt & Company for assistance in carrying out the ingenious and original ideas evolved by Mr. E. Z. Gerould, private secretary to Mr. Hearst, and business superintendent of the paper. It is needless to say that these plans were not evolved in a day or carried through without considerable work and skill.

The Morning Journal and the Morgen Journal occupy the northern half of the Tribune Building on City Hall Park, and their offices on this occasion were one blaze of lights. To begin with, there were two long strings of incandescent lamps, red, white and blue, from the cornice to the sidewalk, the upper ends being marked by large brilliant stars of lamps. Across the top of the building below the cornice stood out the full name of the Journal in lamps; and on the roof were ten Colt photo-engraving arc lamps in a row each with an attendant, and each using about 25 amperes. On the front of the building were seven "balcony" reflector lamps, arranged in two vertical rows of three each and one in the middle. Each of these lamps with a powerful reflector, burned three-quarter inch carbons and required 40 amperes; they as well as the lights on the roof being also provided with color screens. Over the entrance to the Journal office was placed a projection searchlight, with stencil slides, 5 inch condensers, with parallel beam, and using 40 amperes with one-inch carbons.

Across the Park on the City Hall itself were placed two more of these projection searchlights, one on the eastern end being used as a signal for all the others, in change of color screens, flashing in and out, etc. Below the lamps, on the front of the building were two American flags, of lamps, operated with motor and commutator in such a way as to make the flags ripple. Along with these were other set, emblematic pieces.

Directly south across the Park, from the City Hall is the General Post Office, and here fronting on the Park were mounted two more projection searchlights, one at each end, deriving current from the plant in the building. All these projection searchlights threw their beams and their stencil mottoes around in a lavish way, and when a big balloon was sent up by the Journal followed it with their beams until it had let down its flag and disappeared altogether in the dark vault of night.

There were many minor and harmonious effects. All the arc lights of the Brush Company in the Park had been fitted with red, white or blue globes, which shone brilliantly through the trees. A fantastically charming effect was created by long streamers of colored paper tape let loose by the Journal, in every direction, and sent spinning from roofs, from the sidewalk, and everywhere, until trees and buildings and people were all in a maze of these fine threads, which showed up beautifully under the vari-colored and changing beams of the electric lights. Added to all this, was the colossal firework display of the Journal. Its magnitude may be judged from the fact that no fewer than 5,000 thirty-six inch bombs were let off at the height of the jubilation.

Electric Freight Locomotive on the Hoboken, N. J., Shore Road.

THE use of electricity for switching purposes on the steam railroad, in place of the noisy drill steam engine, takes another step forward; this time on the Hoboken Shore Road, Hoboken, N. J. The full name of this road is the Hoboken Railroad Warehouse and Steamship Connecting Company. It runs from 17th street, Weehawken to 4th street, Hoboken, along the water front, or from the Erie tracks at Weehawken to the docks of the North German Lloyd Steamship Company, Hoboken, a distance of about two miles.

This road was opened for traffic on September 20, 1897. It was constructed to provide connecting facilities between the tracks of the railroad companies entering Hoboken and the numerous warehouses and docks which line the West side of the North River from Hoboken to Weehawken. It is double track over a private right of way from 17th to 14th street, single track down Hudson street to 11th street, and double track along the River Walk to 4th street, Hoboken.

The switching of the cars for the past three months has been effected by a repair car of the Hudson County Electric Railroad Company. The new locomotive was put into regular service on January 4, 1898, hauling trains of loaded and empty freight cars between the docks and the Erie track. The difference in its operation from that of the common drill engine is immediately noticeable. The electric locomotive responds instantaneously to the movement of the controller handle and starts without jerk or noise, tightening up the couplings uniformly or coupling the cars together so gently that no jar is perceptible.

The locomotive was constructed in the shops of the General Electric Company, at Schenectady, N. Y., and somewhat resembles in appearance the electric locomotive in use on the Manufacturers' Railroad, which connects with the N. Y., N. H. & H. R. R. tracks at New Haven, Conn., and the giant locomotives now handling the entire freight traffic of the Baltimore & Ohio Railroad, through the Belt Line Tunnel at Baltimore. It is mounted on two four-wheel trucks, each axle

carrying a G. E. 2,000 motor, giving the locomotive a total of 540 rated h. p. The weight on the drivers is 57,200 pounds; the drawbar pull is 10,000 pounds. The locomotive is driven through a single reduction gear of very low ratio. The speed is correspondingly low, and is rated at 8 miles an hour when hauling a heavy load.

At each end of the locomotive is an automatic coupler, and a small railed platform for the brakeman in charge of the trolley pole. The cab is of iron and resembles a double steam locomotive cab, with a sloping tender shield at each end. Drop windows are set around the four sides of the cab, affording an unobstructed view in all directions to the motorman. A sliding door on each side gives admission to the locomotive. The interior of the cab is lined with cherry and is a spacious and well lighted room. The fittings are all of polished brass or nickel. On each shield is a headlight; in addition one shield carries a bell, the other a chime whistle. Beneath one of the shields are four packed card resistances, two sand boxes, the compressed air tank and the equalizing air tank; beneath the other, eight resistances, two sand boxes and the motorman's tool box. At one end of the cab is placed a controller of the series parallel type known as the L-2. It contains, of course, the magnetic blow-out and is arranged to operate the motors either four in series or each two in series multiple. Beside the controller is the air brake handle and the two valves of the sanding arrangement by means of which the sand is blown by the compressed air under the wheels.

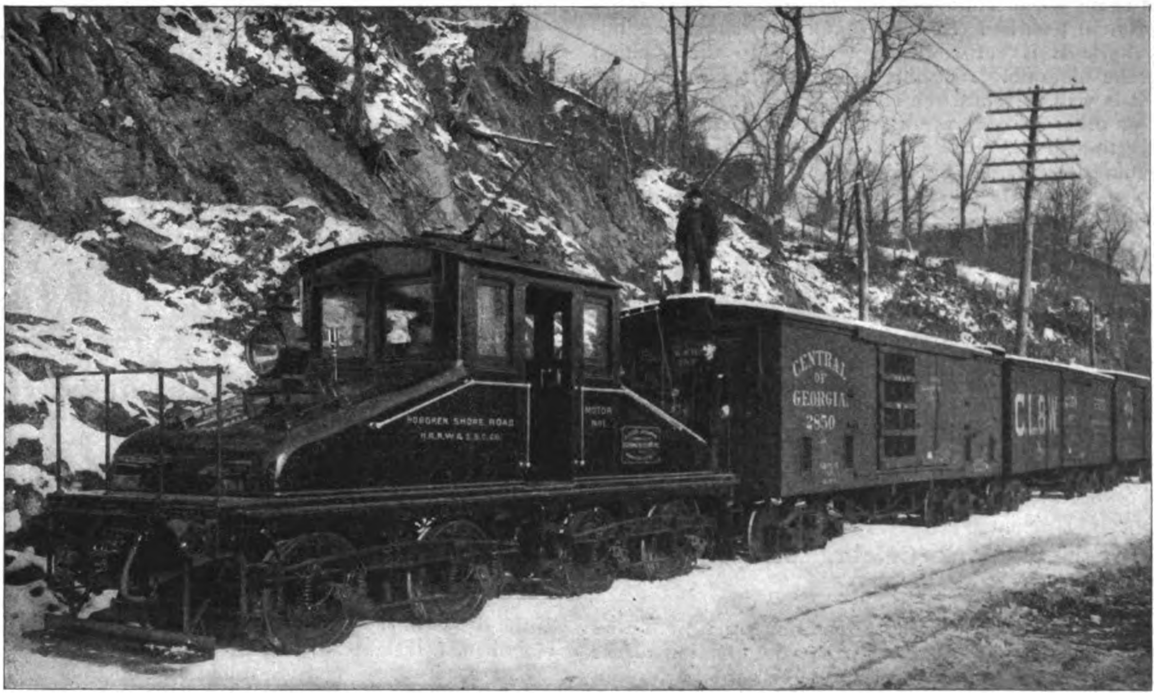
In front of the motorman is an air brake gauge, and above it an ammeter reading to 500 amperes. Fastened to the roof of the cab is an "L" automatic circuit breaker set at 500 amperes. On the other side of the controller, from the motorman, is an "M" circuit breaker and an automatic governor switch for the air pump, placed at the other end of the cab. This is a single cylinder pump driven by a 3 h. p. iron-clad bipolar slow speed motor. The operation of this air pump is automatic. When the air in the tanks is at normal pressure the governor switch is opened. Blowing the whistle, applying the brakes or using the sander causes the pressure to fall. This closes the switch automatically and starts the motor and pump. The cap is lighted by five standard Edison railway incandescent lamps.

The dimensions of the Hoboken locomotive are: Length over all, 29 feet; width, 8 feet; height over trolley stand, 13 feet; wheel base, 5 feet 6 inches; truck centers, 12 feet 9 inches; weight, 57,000 pounds.

The overhead wire is No. 00, suspended from wires strung between octagonal cedar poles, except at two or three points, where bracket construction is used. Where the locomotive turns in from Hudson street to the River Walk, a peculiar condition has caused a special method of bracket construction. It was necessary for the overhead line to be so set as not to infringe upon the limit of the next property. Thus at this point the overhead line is suspended from two bracket arms, one 6 feet and the other 18 feet long. The current for the road is taken from the station of the Hudson Electric Light Company.

The Hudson Shore Road is one of the sub-companies of the Hoboken Land and Improvement Company, organized fifty-two years ago, under a special charter, by the Stevens family to consolidate their interests in their several Hoboken properties. The present head of the Stevens family, Col. E. A. Stevens, is president, and Robert L. and Richard Stevens are respectively first and second vice-presidents; the general manager and treasurer is Palmer Campbell, and the secretary, W. A. Macey.

The trial trip of this locomotive was witnessed by representatives of all the railroads having offices or termini in New York and New Jersey. The locomotive was coupled to eight loaded freight cars with an aggregate dead weight of 295 tons. It handled this train with ease. It was then coupled to a number of passenger coaches and the party made the journey over the line from Hoboken to Weehawken and back.

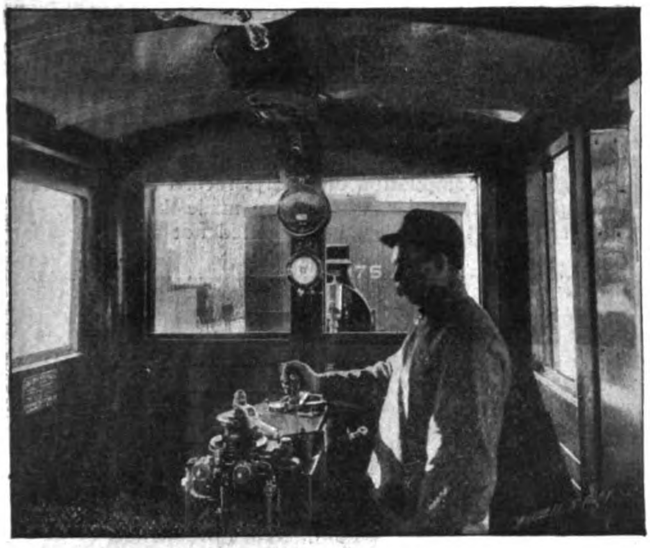


GENERAL ELECTRIC LOCOMOTIVE HAULING FREIGHT CARS ON SHORE ROAD ALONG THE HUDSON RIVER FRONT AT HOBOKEN, N. J.

At the luncheon which followed, two interesting speeches were made. Mr. F. Le Bau, general freight agent of the West Shore Railroad, pointed out emphatically the usefulness of such a road as the Hoboken Shore Road in facilitating the transport of merchandise directly from the steamships to any part of the country, and of the rapid switching electric locomotive, by means of which the freight cars could be handled more easily and more expeditiously than with the ordinary steam drill engine. Mr. W. J. Clark, general manager of the Railway Department of the General Electric Company, in an interesting talk full of reminiscences of the early days of the street railway struggle, said:

"Ten years ago, the development of three things made electric street railways practicable and profitable. These were the under-running trolley, the carbon brush, and the modern method of motor suspension. The development of three other things now renders the general application of electricity to standard railroads both possible and probable. These are the safe breaking of heavy currents, high voltage for their transmission and methods for their application to almost any load

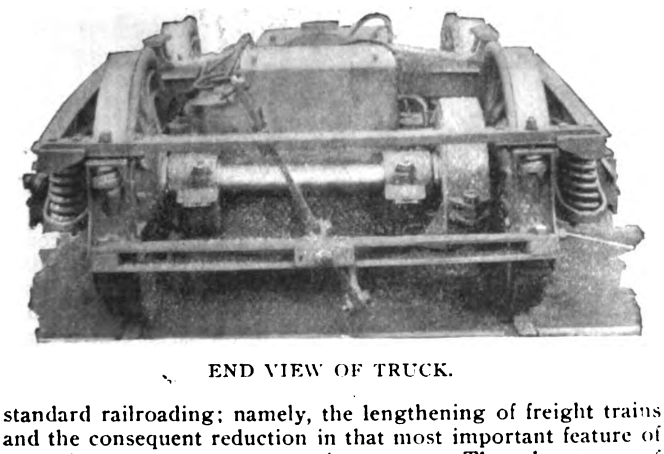
on any portion of a line. Other features are being developed that will seriously affect the result; not the least is the Sprague system of multiple unit control, increasing the flexibility of the already most elastic of all transportation agents, and while the economy of electricity has already been thoroughly demonstrated in performing the same service as by steam or animal traction, so far as passenger service at least is concerned, something beyond the mere question of economy has now to be



VIEW OF INTERIOR OF CAB.

considered; to wit, accomplishment by electrical methods of what would be entirely impossible with steam. The first steam railway man within my range of acquaintance to fully grasp this idea, is Mr. John Lundie, consulting engineer of the Illinois Central Railroad Company, who has set a pace on acceleration that would not have been dreamed of two years ago, and the schedule which he has mapped out for the contemplated electrical equipment of the suburban lines of his company involves a rate up to 40 miles per hour in 20 seconds. That this is practical has already been demonstrated. In fact so high a rate of acceleration has been made as 43½ miles per hour in 20 seconds, so that the practicability of Mr. Lundie's plans has been thoroughly demonstrated. This for passenger service.

"In another direction even greater changes may be prophesied which will come from the adoption of electricity in



END VIEW OF TRUCK.

standard railroading; namely, the lengthening of freight trains and the consequent reduction in that most important feature of operating expense, transportation wages. The advantages of electricity will have so thoroughly demonstrated themselves in the directions suggested that instead of main steam lines with electric feeders, in ten years it will be a question of electrically operated main lines with steam feeders through the sparsely settled districts, and a more extended system of suburban and interurban electric roads in densely populated districts also feeding the main lines.

"The electrical engineer has much to learn from the steam railroad man and must constantly rely upon him for suggestions as to the best methods of making practical applications of electricity. The American transportation man and the American electrical engineer should go on hand in hand, continuing to lead the world as they now do in all transportation problems. The American engineer has won conquests abroad as well as at home; not the least is the solution of the problem of electrical equipment for the Central London Underground Railway, the most important of this character that has yet been accomplished. The American engineering plans were selected on account of their merit in the face of the severest competition from every European electrical manufacturing company, and no greater tribute can be paid to American engineering methods than to state that eighty per cent. of all the railway apparatus used in Europe is designed in America, so that the American engineer stands to-day head and shoulders above those of any other country. With the encouragement of the co-operation of American railroad men he is bound to revolutionize the entire method of transportation within a comparatively short space of time, so that American railroad methods will then, as now, be in advance of those existing anywhere else on the face of the earth."

Trolley Competition in Connecticut.

The annual report of the Connecticut Railroad Commissioners shows that there are 385 miles of trolley road in the State, an increase of about 32 miles over last year. The 29 trolley roads have $9,770,440 of stock issued, of which only $3,106,940 has been issued for cash. Their bonded debt is $9,092,800, and floating debt $1,071,421. They carried last year about 43,000 fewer passengers than they did in 1896. They paid in dividends $265,625, as compared with $221,119 in 1896.

No additional steam road has been built. Owing largely to trolley competition the steam companies carried 2,192,959 fewer passengers than in 1896. Passenger earnings of the steam roads fell off $154,341, and freight earnings $258,003; there are 1,984 miles of steam track in the State. The Commissioners say that no more steam roads are likely to be built in Connecticut. They question the safety from fire of the proposed combined engine and car.

Third-Rail Earnings Nearly Double.

Steps have been taken for the extension of the third-rail electric system from New Britain to Bristol, a distance of about seven miles. The official statistics show that the system now brings in between Hartford and New Britain about $258 a day, as compared with about $135 a day by the old steam railroad service of the two cities.

Exports of American Electrical Machinery.

The following are the values of instruments and apparatus for scientific purposes, mainly electrical machinery, exported from this country in each of the last four years:

1897	$3,054,453
1896	2,522,217
1895	1,912,771
1894	1,534,277

The rapid increase will be at once observed, says the Journal of Commerce, that the exports in 1897 should have been twice as great as they were three years before is striking evidence of the vitality of this business. The distribution of the exports cannot be given for the latest year; for the other three years it was as follows:

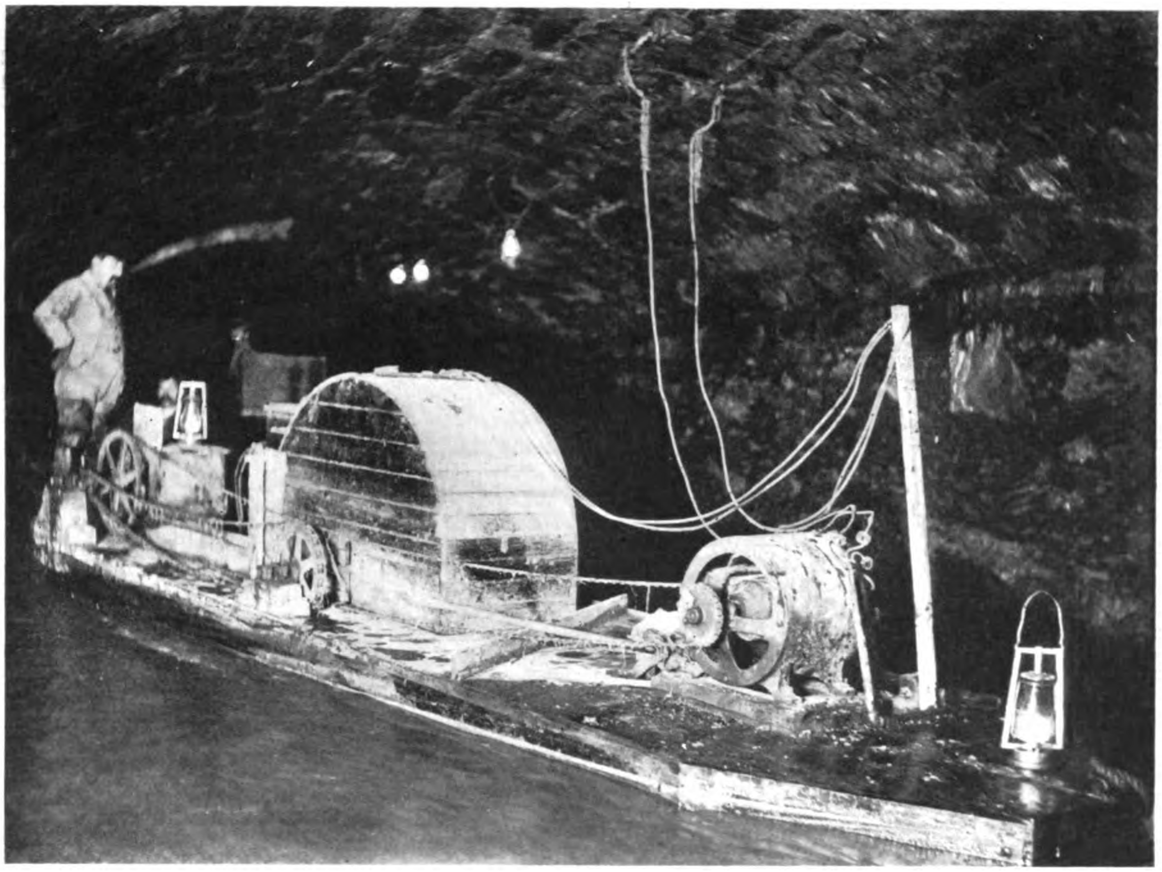
	1896.	1895.	1894.
United Kingdom	$385,575	$340,071	$380,016
Mexico	315,277	223,951	110,864
Brazil	282,798	165,551	100,857
Germany	201,360	135,333	101,515
Quebec, Ontario, etc.	159,375	209,443	170,885
France	158,733	157,625	79,329
Argentina	103,730	23,625	29,382
Japan	98,243	24,861	34,600
British Africa	94,541	17,651	3,359
Belgium	83,702	73,531	41,618
Cuba	54,238	94,149	143,501

METROPOLITAN TRACTION CO. says it is ready and willing to tackle the underground transit problem for the city. It has just made satisfactory terms of peace with its old enemy, the Third Avenue Railroad Company.

Electric Scows in Sewer Construction at Worcester, Mass.

IN the building of a sewer at Worcester, Mass., where electrically driven scows deliver the materials to the workmen, electric lights supply the necessary illumination, electric ventilating fans make work possible and electric pumps aid largely in rapid construction.

That city has a large sewer, eighteen feet wide and thirteen feet high, in which both storm water and sewage are carried away, but as it is desirable to separate the two in order to treat the sewage chemically, a smaller sewer six feet wide is being built inside the larger one, utilizing the bottom and one side of it for the walls. A cofferdam is constructed to enable the other wall to be built, and in order to deliver the materials to the workmen electric scows were rigged up, which work to perfection. About midway between the ends of the new sewer a small wharf has been constructed, and the materials are delivered to it by an incline through a hole made in the top of one wall. The incline and sewers are lighted by incandescent lamps, all the power being supplied by the Worcester Electric Light Company. The double trolley system is used, the wires being hung from insulated brackets in the arch in such a way that a trolley can be run on each.



ELECTRIC TOW BOAT IN MAIN SEWER, WORCESTER, MASS.

The improved towboat is a catamaran twenty-seven feet long and five feet wide, each of the small hulls being eighteen inches wide. In the middle of the deck is a small paddle wheel, boxed in to prevent splashing, and driven through the intermediary of sprocket wheels and a chain by an electric motor. At the stern are a rudder and controller of ordinary form, so that one man can manipulate both. There are six of these boats and they have readily handled 12,000 bricks, fifty barrels of cement and 100 barrels of sand daily. From these quantities it is evident that this original application of electricity is an important factor in the economical construction of this work. Besides lighting, ventilating the sewer, electricity is used to pump out the cofferdam. A special scow is used for this purpose. It is fitted with a motor, rheostat and centrifugal pump and takes the necessary current from the trolley wires. The whole plan has been devised out of second-hand machines and is very inexpensive, but capable, nevertheless, of saving many dollars.

The Saving Effected by Large Transformers

THE economic results obtained from the suppression of old type transformers by those of most recent and improved manufacture, and the substitution of one large transformer for several smaller ones, have been demonstrated very clearly and convincingly in a compilation of reports received from certain electric lighting companies, which have made the change. In almost every case the change has resulted not alone in a far more perfect operation of the system, perhaps a minor consideration, but in an actual, tangible saving in dollars and cents.

Improvement in transformer construction and the use of larger units follow naturally after similar developments already completed in the machinery of many of the large central stations of our country. The replacement of a large number of transformers of small capacity, manufactured when the art of transformer construction was not so well known as it is to-day, by a few improved transformers of large capacity has produced, and is producing, results startling in their importance. The figures shown in the compilation are interesting and should compel the attention of the manager of every station supplying current through transformers.

The first instance is that of a company operating in a town of 56,000 population in Massachusetts. In this case 57 small transformers built in previous years were supplanted by 18 of one of the latest types. The total light capacity of the superseded apparatus was 1,499 lights; of the newly installed transformers 1,624. The total core loss of the old transformers was 5,866 watts; of the new, only 1,348. So much for the electrical facts.

The saving in dollars and cents is calculated as follows: 39,578 kilowatt hours are saved yearly by the change. The value of the saved energy may be estimated at $527.70, equivalent to a saving per light capacity per year of 36.2 cents. Neglecting all the advantages of the change, except those accruing from the decreased core loss, the expense will be met in one year and nine months.

The light capacity of the plant is increased 9 per cent., the core loss decreased 77.5 per cent. Furthermore, on account of the decreased core loss, not less than 4,518 watts are available for sale at the regular rate with the present station apparatus. This enables the company to add 90 lamps to its circuits, producing an additional income of about $675.00.

The second instance is in another Massachusetts town. Here 40 new type transformers supplanted 53 old ones. The total light capacity of those taken out was 1,135 lights, of the new 1,070. The core loss in the old type transformers was 4,845 watts; of the new type 1,343 watts. In this case the annual saving is 30,678 kilowatt hours, or about $409, and corresponds to a saving per light per year of 35.2 cents. The expense of the change, counting core loss alone, will be covered in two years and nine months. Three thousand five hundred and two additional watts are available for sale, increasing the income by $525 per year, while by the use of lamps of a higher economy, some 535 kilowatt hours additional are also available for sale.

There are still three more striking cases in Massachusetts of benefits derived from a similar change. In the first the regulation of the station had been so poor that the lamp bills had increased to such an extent that the question demanded immediate attention. While the saving was comparatively small, the beneficial results brought about by the change have proved highly satisfactory. In the second, 81 small transformers of old type were replaced by 3 of a new type. The core loss of the returned transformers amounted to 2,568 watts, of the new ones 280 watts. The resultant saving per annum is 20,043 kilowatt hours, or $267, the saving per light capacity per year 25.74 cents. This is an all day station and it is calculated that only eight and a half months will be required to wipe out the investment. The third case involves the supercession of 193 old type transformers by 37 new ones, the total light capacity of the former being 6,035 lights, and of the latter 8,210 lights. The total annual saving is 51,203 kilowatt hours, or $683, and the total saving per light capacity 14.68 cents. In five years and two months the cost of the change will be fully covered. The capacity of the plant has been increased 36 per cent., the energy required to operate it decreased 47.1 per cent.; 5,845 additional watts were made available, and thus an additional capacity of about 116 lights was obtained without adding to the station apparatus. If these lights were burned but three hours daily the result would be an additional annual income of $960. On account of the improved regulation entailed by the change, high efficiency lamps can be used and about 410 more watts saved. This adds $109.46 to the total annual saving.

Several interesting changes have also been made in the West. One instance in particular merits attention. The details of the change are not available, but by centralizing the transformer distribution, the rate of switchboard income was changed from 4 cents to 12 cents per kilowatt. Another Western plant reports that its 1,140-volt circuit equipped with old style transformers, showed 6 to 7 amperes in the day time, while with the new transformers only a fraction of an ampere is shown.

Facts such as these tend to prove not only that constant improvement is taking place in electrical apparatus, but that station managers are realizing that, to secure the most economical results on their systems, such improved apparatus must replace older types built when electrical knowledge had not reached its present high standard. A saving here, less trouble there, the extinction of a difficulty at another point, result in a general benefit which can be exactly calculated in dollars and cents, and thus tends to the general wellbeing of the progressive station and communities in which the newer methods are adopted.

LONDON POLICEMEN will, if a plan proposed is carried out, be equipped with portable electric batteries and lights on their helmets, as guides for the public during the delightful fogs which render London preferable to the Riviera in winter.

Niagara Falls Power in Canada.—A Menace to the Great Niagara Plant Overcome.

IN an address delivered before the Canadian Power League at Niagara Falls, Ont., last month, Mr. William B. Rankine, secretary of the Canadian Niagara Power Company, referred to the delays which had been experienced in carrying out the work on the Canadian side. These were largely due, said Mr. Rankine, to the fact that the entire undertaking on the American side involved so much that was experimental that the Canadian company did not feel warranted in going in for work on their side of the river until the American project had been gotten well under way. Besides the mechanical and electrical problems, there were others, and one of a most serious nature, was dwelt on at some length by Mr. Rankine. "We had supposed," said Mr. Rankine, "five years would have been plenty of time, but we had not been able to get our operating and transmission experiences fully, and now we had this other surprise. I did not tell that to the meetings held throughout the Province at that time; I could not as a business matter disclose that, but the fact was that early in 1897, three months before the time when we were expected to begin our work on the Canadian side, we discovered that the walls of our wheel-pit were beginning to come together. We had built a long slot there and we placed in that slot three of the wheels that were to develop 15,000 horse power, and we were going on extending that slot, putting in additional wheels in a row, as the engineers advised, and the same construction which had been adopted in the plans for the Canadian side. All at once in that slot, extending down practically all the 400 feet, the walls began to creep, threatening our plant, and I assure you it was a very creepy time for us. I told Mr. Premier Hardy that we could not make this public, but that he was entitled to know what was going on there, and until we knew where this surprise was going to land us, we could not build a similar slot on the Canadian side in that location. Of course we might find better rock, but we might find worse rock, but we wanted to know the condition to be encountered, the character of the rock, and the effect caused by the cutting of a slot that length and depth. We did not see how we could go on without an extension in the interests of the Canadian Company. That creeping of the rock stopped on the 15th of August, and the only reason I dare to speak of it now is that it has never crept since and we have completely stopped it."

In reply to some statements which had been made that the new electrolytic process industries at Niagara found their chief market abroad, Mr. Rankine said: "I took the trouble to ask each one of the companies on our side and ascertain about their foreign trade. We have six of these companies now taking from us about 7,000 h. p., for use in electrolytic purposes. The Aluminum Company told me they had used last year about one-third of their power to take care of the foreign market which now has fallen off rapidly because of a new manufactory started in Switzerland, and they said there would be no opportunity to use it on the Canadian side except for Canadian trade. I have tried to get them to come over here and establish a 1,000 h. p. plant but have not succeeded as yet. The Carborundum Company told me that their patents for furnishing carborundum for foreign use were owned abroad, and they therefore would manufacture in the United States for the demand in the United States and manufacture in Canada for the demand there. The Electro-Chemical Company, who make sodium, ship nothing whatever abroad. The Oldbury Electro-Chemical Works ship nothing abroad. The Carbide Works manufacture under the Willson patents, and cannot manufacture in Canada. Mr. Willson, a Canadian, controls the cabide patents in Canada and manufactures at Merritton. Now, just one of these six ships abroad one-third of its products and could perhaps manufacture that third in Canada, but will not. It is surely to our interests to encourage manufacturing where we can produce the power cheapest because we can there make the most money. If that is in Canada, why should we not encourage it here?"

Mr. Rankine also stated that arrangements had been made with the Park Railroad Company to deliver 300 to 500 h. p. for local power distribution at once; 1,000 h. p. in addition could be delivered inside of four months, and that could be increased to 5,000 h. p. if necessary. It was not intended, however, that this was to take the place of the proposed larger development.

THE

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The Commercial Status of Telephony.

THE evils of monopoly have so often been dwelt upon in America that it may be fairly assumed every man is familiar with them, as well as with the advantages. The art of telephony has long been supposed to illustrate both sides of the subject, for while on one side the American Bell Company has been painted with all the lurid attributes of the devil, on the other side the public has been informed that the telephone is a "natural monopoly," whatever that may mean; and that the exclusion of everybody else from the field is due to the steady and legitimate absorption of every valuable patent or useful device bearing on the subject. The public as it reads these arguments and statements, pro and con, is free to choose in accordance with its previous condition of mind or purse, for there are some who took up telephone investments when they were a desperate chance just as there are others who would find fault with telephone service no matter who gave it or what price they paid for it.

Meanwhile the whole discussion is slowly but surely shifting to a fresh base, and a more rational, permanent point of view. Patent protection, however prolonged or reinforced, cannot last forever; the stars in the courses fight against it as well as every human passion that delights to aim at the shining mark of prosperity. When all has been said, and all has been done, one gets down to the platform of sheer business ability in conducting a great enterprise and its consequent success in meeting competition or giving public satisfaction. It is right that new ideas and their developers should be protected by patents and rewarded with royalties. It is inevitable that after a time the industry thus created should depend not upon heaven sent inventors, but upon the energy, skill and genius of another class of men, managers and engineers, of not less importance. Telephony to-day has certainly reached this second stage, and is at a point of the utmost interest in its development.

Let us take a concrete example and the nearest—New York City. Here we have a company which, to all appearance, is acting as though it had never heard the blessed word "patent," and as though it might soon be facing the fiercest competition. It is banking entirely, if we may judge from the indications, on the service it can give, and not on presumed ability to exclude a rival from the field. Things were not always thus, and the changes in policy are such as to inspire us to say that the happiest event in the company's history was the expiration of the earlier Bell patents, because it was at once thrown on its real, intrinsic, persistent and permanent qualities of merit. The first and great evidence of a change has been the radical, revolutionary change from a flat rate to a message rate, and thereby hangs the whole tale. It is a curious, striking parallel with the early days of electric lighting, when every light was furnished at a flat rate, and the meter was either unknown or anathema. To-day the electric light industry rests its case on metered current. To-day the telephone companies of the old school are ensuring their future by an analogous metered service of so much per message.

The results last year in New York City proper in the telephone field were in themselves ample vindication of this departure, and of the scientific, equitable system of charge, which cures many evils and eliminates many causes of complaint. It is doubtful whether any electrical industry in New York City, except the local Edison Company, shows such gains. At the end of the year there were in New York City 21,535 subscribers, and in allied Westchester County or Division, 1,880, making the remarkable total of 23,415 subscribers. The gain for the year was 393 in Westchester and 4,749 in New York, or a total increase of 5,142. Surely the change must justify itself to the management by such extraordinary gains. Another significant feature, bringing us back to our text, is the fact that of these no fewer than 17,447 were subscribers on a message rate basis, or 76.2 per cent., while the flat rate subscribers were only 23.8 per cent. Nor is this all, for the flat rate subscribers were steadily getting off the old basis all the year through, 485 changing in 1897, so that at the end of the year only 3,730 were left; and the revolution still goes on. It would be very interesting to learn how the situation is in other cities and whether they can compare with New York in this respect. We doubt it.

And this brings up the question agitated very vigorously by one of the city newspapers last week, which, quite oblivious of this notable change to a metered basis, began to talk about New York, Paris, London, Berlin, etc., as though the old basis still governed and as though a surface comparison could be fairly made, anyhow. Outside altogether of differences in rents, salaries, cost of materials, etc., all making for higher rates in this country, there are other things not mentioned. In Paris, for example, until quite recently, when you wanted a man, it has been necessary to give central his full name and address! That little fact alone is indicative of the modernity and efficiency of the service. How would a New York business man like it? In Berlin, the Government is now proposing a new scale of charges with all kinds of discrimination, the very contrary of the New York ideal of getting just as near a common, universal charge for the exact service rendered. Yet Europe is constantly held up as an example, whereas in every line of electrical service it is from ten to fifty years behind the United States, and does little else but adopt our inventions or copy our practice. If a service is in the hands of the Government, the price asked for it is utterly without value as a criterion of its cost. If the service is in the hands of a private company, it usually comes nearest perfection when carried along according to American methods and ideals.

Two-Rate Metering.

THE success of an electricity supply company depends upon its ability to deal with the public, for though its mechanical and electrical equipment may be of the best, its staff the most skilled, and its local resources abundant, there still remains the hard fact that the public is the judge and dictates success or failure. The income of a company, upon which depends its life, comes from a neighboring public whose opinion is paramount and final.

When electric current distributing companies were first started, little attention was paid to the effect of "fixed charges" upon the cost of the current since rates were high, the commodity new, and only indulged in as a luxury. In those days it was supposed that the cost of electrical energy depended upon the quantity generated at any one time and—since consumption was instantaneous—the quantity sold at any one time. Thus, favorable terms were made to consumers in direct proportion to their maximum demands. As central station plants became better organized and their business more extended, associations were formed for mutual benefit, and it was soon seen that companies having the same maximum output did not show the same unit cost for energy even when the prices of coal, labor and the different items making up the cost were at the same rate. This led to a careful comparison of local conditions and among other things the generating

and selling curve. It was then found that those plants having the highest percentage of average to maximum output were able to show the lowest cost per unit. Then, as will be remembered, came the introduction of the electric motor in an endeavor to increase this percentage output. In the meantime, to make the income more nearly correspond with the cost of generation, the flat or contract rate system was abandoned and the meter substituted.

While the meter had the desired effect of placing the business on a better financial basis it did little to improve the percentage of average to maximum load. In fact, in the majority of instances the meter system diminished the use of the current during the minimum, rather than the maximum, period, thus at once lowering the percentage and increasing the unit cost. In order to introduce the electric motor, selling prices for this device only were lowered during the motor period (which unfortunately often came during the maximum period), and thus, in the opinion of many companies, a paradox was presented; for it was always supposed that the unit cost of energy varied directly as the quantity, and yet it was found that by lowering the selling price during the seemingly high cost period, the average cost per unit was reduced.

As prices to the public were lowered, as the commodity developed from a luxury into a necessity, there came about a careful analysis of the cost per unit and the surprising effect of "fixed charges" became prominent. It was seen, in effect, that as the generation and supply were coincident the element of time was all important; but while for many years this fact was recognized, no definite application was proposed while dealing with the problem from a purely current supply situation leaving the option of use to the customer.

Mr. W. S. Barstow's "load factor system," explained by him elsewhere in this issue, is, we believe, a simple and effectual solution of the situation, reducing the supply of electrical energy to a percentage-on-manufacturing basis, which is the recognized foundation stone of all industries. Mr. Barstow's article clearly sets forth the reasons for the use of a two, or more, rate system.

A device for carring such a system into practical effect is also described in this issue, that of Mr. Oxley, showing how simply the system can be carried out in practice.

There is to-day no question which touches the central station manager closer than the question of rates. With the light thrown on the subject by Mr. Barstow we feel certain that it will be only a question of time when such a variable rate system will be in universal use, for the reason that it is a fair system—fair to the consumer and fair to the current supply company. Its introduction will be hastened when it is realized that such a system is a great load evener, and what that means needs not to be pointed out at this late day.

Electricity on the New York Elevated Railways.

AT last, it seems that the electrical conversion of the New York elevated railroad system is within measurable distance. We judge so, at least, from the authorized public utterances of Mr. George Gould who, in an interview, states flatly that the introduction of electricity on these roads has been decided upon and that the work will be carried out with the least possible delay. This action of the Company was somewhat foreshadowed by Mayor Van Wyck's annual message, and it is probable that the announcement of Mr. Gould, coming so quickly after the mayor's message, is not a mere coincidence. Whether this be so or not, the fact that the proposed tunnel railway scheme has for the present received a decided set-back makes it more desirable than ever that the elevated railways should be brought up to the highest possible state of efficiency and convenience to the public. That this can be done by electric traction no one will now care to deny in the light of the experience gathered in Chicago and Liverpool in elevated railway work. Of course, no other plan but the third rail is thought of so far as the system of current conductors is concerned, but as to the other details no facts have as yet been forthcoming. We fancy it will be a battle royal between systems of electrical control, such, for example, as between the locomotive car and the multiple unit individual motor car system. Then again, as to methods of current distribution; whether a number of power plants will be located along the lines, or a big central power plant installed generating high tension alternating current to be converted locally by rotary transformers. And who knows but that the alternating car motor may enter the lists as a competitor? Of one thing we feel certain, however, namely, that no matter what system is adopted, it will be an improvement over steam. New York has suffered long and patiently, and its deliverance from a continuous shower of dust and oil and from steam and noxious gases comes none too soon. Indeed, probably no other city on the face of the earth would have exhibited the equanimity and good nature which New York has shown for the past twenty years. It is to be hoped that the change over will be proceeded with without delay and thus add another factor to the improvements now so rapidly manifesting themselves in the metropolis of the Western Hemisphere.

While the above was being put in type, a rumor gained circulation in New York that at last a genuine contract had been awarded by the procrastinating Elevated management, and that the Walker Company has the contract to equip, as a start, the Second avenue line. This is not confirmed; neither is it denied, and one of the city papers has gone so far as to reproduce from our columns the drawings and data of Prof. S. H. Short, on the equipment of the New York Elevated, printed last August. We hope this is true, and shall be glad to see any such contract awarded, as it will mark the beginning of a now inevitable transformation. It is said that in return for the change to electricty, the Manhattan Company will secure the right to build spurs and extensions. Mr. George Gould is quoted as saying, that the adoption of electricity would result in a saving of at least 2½ per cent. The roads to-day are running 3,500 trains daily with 330 steam locomotives.

Politics in Detroit Lighting.

DETROIT continues to furnish a good deal of interesting matter in connection with the operation of its municipal plant; and now we have a very interesting article on the subject from Mr. George E. Fisher, a local electrical engineer of more than local reputation. He falls foul of Mr. Fitzgerald and one or two other men in great style and makes a number of striking statements. We think that anyone reading carefully Mr. Fitzgerald's article and this reply by Mr. Fisher will come to the conclusion that "politics" had vastly more to do with the putting in of the Detroit Municipal Plant than any real question of economy. The politics were also evidently pretty hot and so continue.

Mr. Fisher's comments on the results with the plant seem to us open to one comment, from ourselves, namely, that his figure of cost is not correct. It has already been pointed out in these pages that the alleged cost of $89.42 took no account of any insurance, or of depreciation, except on the single item of boilers; and that assuming 5 per cent. as fair, the actual cost per lamp was at once brought up to $102.49. Central station managers would be glad to meet their depreciations at 5 per cent. In commenting on our figures, president Hudson, of the Detroit Lighting Commission, said: "My own figure for an arc lamp has always been $100." We venture to point this out to Mr. Fisher, and to repeat our previous comment that the figure of $89.42, like the old Barrett figures in Chicago, might as well be dismissed right off from consideration, as not representing the actual facts. We would also like to call his attention to the official report just filed by Mr. F. L. Barnett, superintendent of city lights of Des Moines, Ia., in which he says that the item of $89.42 is expected to be at least $94 in the third year and adds: "I was advised that Mr. Dow, the first superintendent of the Detroit city plant, lost his position for having estimated that in ten years the cost per lamp in Detroit would not be far from $120." Nor is this all. Mr. Barnett has just visited Buffalo, and points out that there the price from the local company is only $109 for 2,300 lamps, and is to be $100 when 2,500 lamps are required. "The lighting service of this city is by far the best of any city visited; in fact, it is the best lighted city I have ever seen." We beg to extend our congratulations to Mr. Huntley upon this handsome compliment paid his work in Buffalo as a central station manager.

TELEPHONY AND TELEGRAPHY

Cable Coding and Cable Addresses.

THE increase in the number of Atlantic submarine cables, and the rapidly growing use of them in international affairs, have been responsible for a great development in the art of "cable coding" and "cable packing," or getting one word to express the exact meaning of forty or fifty, so as to reduce the amount paid for messages sent under the ocean. Some of the achievements in this line are very remarkable. although the fullness of many of the dispatches sent without cipher or code is not less striking. The lower rates for cable messages have not only increased the volume of business, but have made it absolutely necessary for every concern or individual with any kind of connections between this and the other side of the Atlantic to have a cable address. But this is not all. Where one is cabling frequently, the registered cable address of the correspondent is easily remembered; but there are occasions not a few when it is required to reach parties in a hurry whose cable address is not known; and the absence of a directory of this character has often been keenly felt. In fact, the want became so obvious that last year Mr. Chas. P. Bruch, a well known telegrapher, and now assistant secretary of the Postal Telegraph Company, undertook in association with Mr. C. W. Parker to get up a cable address directory. He soon found that the idea was appreciated, and as the work developed other well known officials of the Commercial Cable and Postal Telegraph Companies came to his aid. Last October, the scheme had taken on such importance and magnitude, that the Commercial Cable Company itself, realizing the value of the enterprise and desiring to have it as fully rounded out as possible in the accomplishment, took the significant step of guaranteeing the issue of 100,000 copies of the Atlantic Cable Directory and Code, thus gathered together; and also guaranteed the circulation of the books abroad.

The labor upon which Mr. Bruch has thus found himself engaged is nothing short of monumental. The book will reflect great credit on its compilers when it appears, and it would have been out some weeks ago, but for the intense desire of its authors to make it perfect and but for the inevitable tendency that such works as dictionaries, directories and encyclopædias have to grow in bulk and scope as they roll along. We have lately been afforded an opportunity to go over some of the printed sheets and later proofs with Mr. Bruch at his office in the Postal Building, and must confess our satisfaction at what has been done. The book itself, with a page face 10½ by 7 inches, was laid out for 600 pages; just how many beyond that it will run we would not like to pay for. The mere preparation and publication of 100,000 copies of such a book involves tremendous work, quite apart from cost; but that is only one side of the undertaking, and there are others of equal interest. To meet the outlay, the insertion of names has been by subscription, the name, business, business address, cable address and one classification being inserted for $12.50; while an additional classification is given for $2.50 extra. In return for this, each subscriber gets one copy free, and can have extra copies at $1.50 each, with discounts on quantities; making the book very cheap. The Atlantic Cable Directory and Code Company hopes also to meet its heavy expenses in some degree by the insertion of advertisements, such a book, lying always on 100,000 desks of buyers and sellers, having a distinct value in that direction.

These cable addresses now numbering roundly about 5,000 are arranged alphabetically by States, cities and names; supplemented by a classified business directory; and the collection is a marvellously complete and intersting one, because it presents in a way we have never seen before the business people of this country and Canada who have foreign relations for commerce, finance, etc. The growing nature of our banking business, the long arms our makers of machinery are reaching out, the growing field for our iron and steel, the big market for all our agricultural products—these and other features are all impressively brought to notice in the endlessly long lists of names that Mr. Bruch has for months been arranging with a lavish consumption of time and with an enthusiasm of no ordinary degree.

That, however, is but one-half of the story. The directory contains a cable and telegraph code of at least 50,000 words, selected from the official vocabulary authorized by the International Telegraph Bureau at Berne, and conforming strictly with the instructions of the Buda Pest International Telegraph Convention of 1896. But within that liberal range of 50,000 words, there are, as every experienced cable operator or telegraphic expert knows, many chances for hit or miss, many openings for bull and blunder; and Mr. Bruch has not only gone over every one himself, but a second specialist has been detailed to check up everything, with the sole object of rendering a cable message in code possible of one interpretation, and of one only. Here, too, is where the "packing" comes in, and every cable sender has been invited to contribute to the general fund the little wrinkles and phrases and cues that he has found best in his own line of work. The mine of experience thus opened up and the innumerable hints and suggestions thus poured into the hands of the company for digestion and assimilation, are simply surprising. Licking all this material into shape—some of it very unexpected—takes time, skill and patience; but when the Code comes out it will be all the better for the unavoidable delay that has in reality added to its intrinsic worth and utility. Every word in the Code will not only have the authority of the Berne and Buda Pest Conventions and agreements behind it, and therefore be acceptable at every cable office in the world, but it will have been sized up for the best service it can render in cutting down the number of words for which a cabler has to pay. Another excellent feature we note in the pages of the "Directory Code" is its shrewd and generous reserve of words to which those who use it can attach their own meanings and phrases. Every page carries this surplus, so that the owner of the book has a ready made code and a code he can make for himself, all in one.

The cable addresses are an interesting study, but we have room for only one or two of them, in our own field. The Western Electric Company has "Microphone"; the General Electric Company, "Genetric"; the Crocker-Wheeler Electric Company, "Crockwheel"; Shaw Crane Electric Company, "Cognition"; C & C Electric Company, "Electmotor"; H. B. Coho & Company, "Cohocomp"; Dodge Manufacturing Company, "Dodmanco"; Dyer & Driscoll, "Vernerve"; Eaton & Lewis, "Nerdis"; Herzog Teleseme Company, "Teleseme"; Johns Manufacturing Company, "Wardjohns"; McIntosh, Seymour & Company, "Toshmour"; The Okonite Company, "Okonite"; Spencer, Trask & Company, "Trask"; Westinghouse Electric and Manufacturing Company, "Converter." These are suggestive, some of them clever, and the whole list—if we may venture a mild pun—a very witches' Bruch of nomenclature.

The officers of the Atlantic Cable Directory and Code Company are: President, Geo. Clapperton, traffic superintendent of the Commercial Cable Company; vice-president, T. L. Cuyler, Jr., assistant treasurer, Postal Telegraph Cable Company; secretary and treasurer, Chas. P. Bruch, assistant secretary Postal Company; and general superintendent, C. W. Parker. These are directors, with Albert Beck, C. E. Merritt and W. K. Smith, all three well known officials in the Commercial Cable Company.

The Rutherford Secret Sounder.

THE introduction of typewriting machines in telegraph offices on which operators take down the messages as received has necessitated increasing the volume of sound emanating from the sounders in order to make their clicks clearly distinguishable above the click of the typewriting machine. The result has been that the noise in telegraph offices has in many cases increased to such an extent as to be a serious menace to the health of operators. Besides this, greatly increased all-round noise to large extent vitiates the effect of the sounder resonators.

It was with a view to reducing this noise and to make the received message entirely secret, if desired, that Mr. G. A. Rutherford has designed what has been called a secret sounder, which is illustrated in the accompanying engravings.

The sounder which is enclosed in a hard rubber case, is very light, the whole thing with conducting cord complete, weighing but four ounces. It can be used not only without

the slightest inconvenience to the operator, but much to his comfort and advantage; relieving him of all unnecessary nerve and physical strain. It can be attached directly to the main line where it acts as a combined relay and sounder, giving all the services of both, without any of the disadvantages and annoyances of a main line sounder.

The mechanism of this little instrument is very simple, consisting, as shown in Fig. 1, of a set of electro-magnets of from 2 to 150 ohms resistance (according to requirements). An

FIG. 1.—THE RUTHERFORD SECRET SOUNDER.

ingenious arrangement of the armature and lever, brings the former in actual contact with the poles of the magnets in such a manner as to double the working force of the magnets, and insures a much more prompt action of the armature than has been heretofore obtained. The armature lever is provided with hammers, which, in action strike upon a resonating plate; a shifter or switch at the side of the case draws the hammers from the plate and reduces the sound to a minimum. The adjustment of the retractile spring is absolutely direct, and is made from the outside of the case, although it is rarely ever necessary to touch it.

The engraving gives a view of the interior construction of the sounder with the cap or cover removed, and shown on the right. The cap is threaded, and is tightly screwed in place when the sounder is in use. There is never any necessity of removing the cap. The shell, enclosing the sounder, and the head band are made of hard rubber, and the parts of the instrument of aluminum and brass.

Owing to the loudness of the sound when the hammers

FIG. 2.—THE RUTHERFORD SECRET SOUNDER AS APPLIED TO OPERATOR.

strike upon the resonating plate, messages may be received with the sounder placed on the table or desk, and in this way it may also be used for a call; thus combining in one instrument both a loud and secret sounder, something which we believe has never been accomplished before. Should it be desired to take a secret message, the sounder is adjusted from the outside by means of the shifter above referred to, which is graded so that the operator may regulate the volume of sound to suit his own ear. This may be from the faintest click to the full volume of the loudest sounder. The instrument is then worn on the head, as shown in the engraving, Fig. 2, and messages may thus be taken known only to the sender and the receiver. The instrument being worn next the ear may be adjusted to its lowest capacity and still be distinctly heard by the operator, a great boon to one suffering from deafness. The case and head band being made of hard rubber, insures the operator from shock from abnormal currents passing over the line.

This instrument, as stated above, is especially adapted for use in offices where the typewriter is used in connection with telegraphy. For the secret service of the Government, for line inspectors, and for testing purposes the Rutherford secret sounder is also especially adapted, and it will no doubt find an extensive use in stock exchanges, brokers' offices, newspaper offices, etc. For local use these sounders are made with from two to twenty ohms resistance; for main line use the magnets are wound to a resistance of 150 ohms or higher. The sounder is manufactured by the Secret Sounder Company, of 115 Broadway, New York City.

Bell Telephone Instrument Output.

The American Bell Telephone Co.'s monthly statement of the output of instruments for December is as follows:

Gross output	26,374	Inc.	12,634
Returned	8,799	Dec.	1,102
Net output	17,575	Inc.	13,736
For the year ended December 20:			
Gross output	241,271	Inc.	49,185
Net output	148,404	Inc.	51,091
Total outstanding December 20	920,693	Inc.	148,404

The Roberson Quadruplex Between New York and Buffalo.

Tests of the Roberson quadruplex, described in our issue of September 30, 1897, are being carried on continuously by the Western Union Telegraph Co., from New York as a center. The Roberson quad having proved so successful between New York and Washington, it was early in December tried on the line between New York and Buffalo, a distance of 430 miles. It has been working almost continuously since then and with very satisfactory results.

Long Distance Telephony and the Railroads.

Wiht regard to the effect of the long distance telephone on railroad passenger patronage, that shrewd observer, Mr. Chauncey M. Depew says:

"There is no doubt that the long-distance telephone is affecting short-distance railroad travel to a considerable extent. By short-distance travel I mean that within a hundred miles or less of the cities. One reason is that manufacturers who used to communicate with their offices and stores in the cities by messengers or by some member of the firm or corporation going to and fro frequently, now find that they can do business as well and with a saving in time by using the telephone. Then the country merchant who used to go to town once a week to replenish his stock finds that he can replenish it daily, if need be, by using the telephone, according to the demands of his business. Thus he does not have to carry so large a stock, but lets the wholesaler carry it for him. His wife knows this, and so he no longer has a good excuse for going to town often.

"These I look on as the regular sources of railroad travel that are cut off by the long-distance telephone. Now for the irregular sources. Social communications over short distances are now performed to a large extent by means of the telephone. The shopping business is another important factor. Take people living within 25 or 30 miles of a good-sized city, they mostly have telephones in their houses, and, instead of going in for shopping purposes at short intervals, they call up the stores by telephone, and only go shopping in person occasionally. Then if we take places like Syracuse, Rochester, Utica, Albany and their outlying districts we find that a good deal of business is done by telephone, and much railroad travel for short distances is saved to the people.

"All these things taken together show that a large amount of business is thus cut off from the railroads. But the increase of population is making up for the loss thus occasioned. In other words, the telephone keeps the factories at the little places, while the main offices are in the larger ones. It is so with all inventions: at first they seem to be injurious to certain interests, but ultimately they prove of advantage all around."

Some Views on the Municipal Plant Situation in Detroit.

BY GEORGE E. FISHER, E. E.

YOUR issue of the 23d ult., under "Municipal Affairs" contains an article evolved from the mind of Mr. William H. Fitzgerald, manager of the Detroit Electric Light and Power Company, which article is so misleading that it seems an injustice to allow such an elaborate misrepresentation of actual facts to go unchallenged, and if such an article were published in a Detroit paper, would make the writer of it the laughing stock of the city.

The writer is very familiar with all of the incidents leading up to the installation of what we consider the finest municipal lighting plant in the United States, but I do not reply with the idea that it will counteract the influence his article might have to "prevent other cities from following our example."

He states that "Until the tide of feeling favoring municipal ownership struck us the service given the public was generally satisfactory." This statement is so decidedly erroneous, especially as applied to the company which he represents, that the twelve or more victims of this same management who met death prematurely should arise from their graves and expostulate. Vulgarly speaking, the service was "rotten," a statement which every unprejudiced citizen will substantiate. The Detroit Evening Journal of September 15, 1894, publishes a list of the men killed by the Detroit Light and Power Company's plant under Mr. Fitzgerald's management, and subsequent events under municipal ownership clearly demonstrates that either this company were operating a very inferior plant or it was being operated by a very inferior management. Why did not the gentleman think of the large investment of the stockholders in the Brush Company (former contractors), who were also among "Detroit's largest taxpayers," when he assisted in organizing a company to compete with them, thereby placing his former employers "in such a position to have their property sacrificed."

Personally I am not an advocate of municipal lighting, except under certain conditions which exist locally, and if any municipal corporation was justified in municipal ownership, the City of Detroit was the one. Why?

The contract price with the Detroit Company was $132.41 per light per annum, which, considering the large number of lights and other local conditions, the most antagonistic citizen will admit was an excessively high price. Prior to the expiration of the three years' contract, R. T. McDonald, manager of the Ft. Wayne Electric Company, who was largely interested in the Detroit Company, obtains control of the Brush Company, the former contractors, and assumes its management, securing the purchase price by an issue of bonds to the original stockholders, thereby preventing competition from that source when the three year contract expired and incidentally settles pending litigation on tower patents. At that time there were two sets of towers in the city, and in order to relieve future contractors of the burden of putting up towers at an enormous expense, bids were received by the City Controller for them. Did either of these two companies offer to sell their towers? No. Mr. Fitzgerald came into the Controller's office (the writer being present), and when asked for their bid on towers, smiled sardonically and stated they had no towers to offer.

The writer with other Detroit people who also "share the burden of taxation" discovered, through a prominent attorney, an old English patent on towers, which satisfied us that the patents controlled by Mr. R. T. McDonald and his colleagues were valueless and we offered towers to the city, covering our bid with a certified check for the amount required by the specifications. These gentlemen probably did not know that one of the objects in receiving bids on these towers, was to expose the collusion between the two companies, and from that time on Mayor Pingree, Controller Black, and others, left no stone unturned to break up this local combination and the carefully-laid plan to mulct the City of Detroit for thousands of dollars annually.

Now let us see why Mr. Fitzgerald could not sell his plant to the city.

The Commission consisted of six of Detroit's best citizens, and one, and only one, was ever interested in the Brush Company. That was J. L. Hudson, who was not a stockholder at the time he was appointed, as all of the stock was controlled by Mr. R. T. McDonald. Mr. Fitzgerald's assumption and presumption in criticizing the acts of a man like we all know J. L. Hudson to be is misplaced, and the writer is very positive that if Mr. Hudson actually owned controlling interests in the old company he would have sacrificed it all rather than perform a dishonest act as an honorable member of the Public Lighting Commission.

What part of the plant could the City of Detroit have purchased and secure an installation equal to what it is now operating? The steam plant? No, as we do not think it would have been wise to have installed second-hand boilers and engines, even if they were of "modern" type, nor could they have afforded to have bought the dynamos, as they were small units and modern practice in large plants proves that the large units are preferable. Surely they could not expect the city to buy the Fort Wayne rack feed lamps which were never adapted for outdoor service and have since been abandoned by the company themselves. The underground system has also been abandoned with the exception of a few small pieces and was a complete wreck at the time the city was negotiating for a plant, most of the circuits in the underground territory being run overhead by Mr. Fitzgerald's company.

With a record of seven men killed, surely it would be unfair to assume that Mr. Fitzgerald was personally responsible for this, so it must have been the plant, and that in itself would justify the city in letting it severely alone; and it was not until the other arrangements had been practically agreed upon that the Detroit Electric Light and Power Company seemed to realize that they were beaten and that their scheme was knocked out.

From figures that I gather, including interest on bonds, wear and tear on plant, etc., it has cost the City of Detroit $89.42 per light per annum, a saving of over $43.00 per light or $77,000.00 per annum. This is quite satisfactory to the citizens of Detroit, and we do not think any twisting of figures or an evasion of facts, notwithstanding this gentleman's efforts, will convince the citizens of Detroit or in "the many cities throughout the country regarding the lighting of Detroit" that we did not achieve a magnificent success, and that the service is so far superior to that rendered by the Detroit Light and Power Company, that comparison is impossible.

I might add that since the time this fight was settled, the Fort Wayne Company have stepped down and out, and the old Brush Company is now doing a successful business at the old stand, being in the hands of its original owners. How would private consumers be treated now if McDonald and Fitzgerald's scheme had worked, and what an elegant thing another contract would have been for these gentlemen; while now we are getting good service in our city lighting and genuine competition in commercial lighting.

How Municipal Authorities Protect Public Health.

The State Board of Health cannot get at the actual number of cases of contagious disease in the State when over 100 places refuse figures. The law of 1893 fixed a penalty, which was that if the Board of Health of a city or town refused or neglected to furnish the notice, it should forfeit its claim upon the State for reimbursement where it had expended money for a person ill with such a disease, who had no money or no settlement. In all such cases the money is paid upon the approval of the bill by the State Board of Lunacy and Charity. The Board of

Health has now arranged with the Board of Lunacy and Charity to be notified whenever such a claim comes in from a city or town which does not furnish notices, and the auditor will be notified in turn of such neglect before the claim is paid. —Boston Transcript.

Public Control, Ownership or Operation of Municipal Franchises?—II.

With Special References to Electric Lighting.*

By R. R. BOWKER,

(Vice-President and General Manager New York Edison Co.)

VARIANTS IN COMPARATIVE STATISTICS.

IN such a comparison of industrial services, several classes of variants must be taken into account—as between industries, as between localities, as between complete or imperfect statistics and as between different methods of statement. Most of the tabulated returns put forward by those not acquainted with the respective industries furnish no real basis of comparison and are misleading. In England, however, the Board of Trade requirements afford a basis of comparison more nearly adequate, and it is gratifying that the United States Bureau of Labor is entering upon a careful comparison in the lighting industries, which has been planned to cover very nearly all the variant conditions.

As to variants between industries: Water can be stored cheaply for use at any time and suffers no loss except a slight evaporation and leakage. Gas supply for ten hours can be stored cheaply, with perhaps 10 per cent. loss in gasometer storage and in distribution through mains. The price is, therefore, usually the same to all consumers and at all hours. Electricity must be produced at the instant of demand, unless stored at a loss of 25 per cent. in costly storage batteries. Of the generating machinery required at the hours of maximum use, a quarter is utilized less than 100 hours in a year, and the loss in transmission reaches from 10 per cent. to nearly 40 per cent., the last on alternating systems which energize house converters through the whole 24 hours. The price, therefore, differs greatly with the conditions of supply, and electric current can profitably be supplied through 10 hours at a third the price charged for the "maximum" two hours. Street cars and suburban trains are chiefly in demand morning and evening. The telegraph can defer part of its business as night messages; but the telephone must instantly supply each demand and, contrary to most other industries, the operating cost in a large system is greater than in a small one, since a "central" of 50 subscribers need make but 2,500 combinations, while one with 5,000 subscribers must provide for 25,000,000 combinations at greatly increased cost. Even within city limits the cost of service is somewhat greater with distance, but it does not seem fair that a customer to whom the source of supply is not near should be charged more than one close by, and in American cities street car fares as well as gas and electricity charges are usually generalized into a uniform rate. In the early days of postal facilities a pony express letter to San Francisco was a costly affair, but a 2-cent stamp now carries a letter either across the street in New York or across the continent to San Francisco.

As to variants between localities: The density of population, not only in a city, but in the area supplied, is an important variant in cost. Fuel and water costs vary greatly. In New York hard "pea" coal costs about $3 delivered, or $2.50 "alongside" dock; in Chicago soft factory coal is delivered to riverside factories at about $1.10. Some Western cities use natural gas or oil. Ratings are different in different localities, as in the candle power of gas and even in the definition of candle power, which is different on the Continent from that in England and America. In London electric incandescent lamp "equivalents" are usually based on the 8 candle power lamp; in Paris, on the 10 candle power lamp; in Berlin and American cities, on the 16 candle power lamp. European prices for electric lighting usually do not cover the installation and renewal of incandescent lamps. American prices usually include them. The standard arc lamp of 425 watts in the arc or 450 watts at terminals (10 amperes of 45 to 50 volts) is nominally of "2,000 candle power;" but this lamp is spoken of in the New York contract as of "at least 1,000 candle power," and entered in National Electric Light Association returns as "1,200 candle power;" while the high tension arc light rated in Brooklyn as 1,200 candle power is of 325 watts, or 7 amperes. Overhead supply is much cheaper than subway supply, the New York rentals equaling $40 to $50 per lamp where street lighting only is supplied. Some of these latter variants are really variants in terminology, that is, in the different use of words or names in different places.

There are usually many variants in the comparisons, especially tabulated comparisons, between municipal returns and those of private corporations. A private corporation pays taxes and a municipal industry does not. Interest, maintenance and depreciation charges are often overlooked in municipal industries. Legal charges are usually in municipal industries charged to the corporation counsel's office and not to the industry. General expenses, such as auditing and the cost of the central administration of the city, are commonly among the many forgotten elements in municipal accountings. The return of the private corporation to the State or city in indirect ways is usually not credited in such comparisons. In Paris, for instance, the price of gas should be considered for comparison as $1.35 per thousand cubic feet, because 28.6 cents of the price—$1.64—is paid back to the citizens through the municipality or the national taxes.

A company supply cannot be compared with municipal supply unless the charter also is for an entire city exclusive and permanent, as is usual under municipalization and is possible, under proper safeguards, in chartered companies.

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the business cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

Municipal Plant Politics at Thompsonville, Mich.

The recent village election at Thompsonville, Mich., was won by the anti-improvements faction. Since then electric light and water plants, established by the previous administration, are alleged to have been neglected and now the water works have shut down for an indefinite period, leaving the town without fire protection. It is charged that there is a shortage of $490 in the village treasury.

Taunton, Mass., Municipal Plant Afraid of Competition.

Nomus Paige, manager of the Taunton municipal lighting plant, has submitted his first report to Mayor Fish. The report in the future will be annual. At present it covers only the period from July 1 to the close of the financial year. The whole report is of interest, showing as it does the results of the experiment into which the city entered this year. One of the most striking features of the report is that, by leaving out interest and depreciation allowances, the commercial work is made to show sufficient revenue to meet all operating charges, maintain 116 lights free of cost, and leaves a balance of $334.04. Mr. Paige recommends the wiring of school houses for the system and the inauguration of meters in the commercial service. He deprecates the action of the aldermen in granting a franchise to a competing company last September, and thinks it will prove a dangerous mistake. The plant now furnishes 164 commercial customers, an increase of 11 since July 1. There are 5,000 incandescent lamps in use, 111 arc lights and 80 horse power in motors. The plant includes a four-story, brick building, 5,000 incandescent and 520 arc light dynamo capacity, 100 horse power in motor power, a boiler capacity of 450 horse power, and an engine capacity of 665 h. p., 65 miles of street wire and 800 poles.

SOMERVILLE, MASS.—A resolution in favor of a municipal electric lighting plant has been voted down by the aldermen, by a vote of 5 to 3, and in the Council by a vote of 8 to 7.

MR. D. J. McCAZINE, manager of the Gunnison, Cal., Gas and Water Company, writes us: "I have found The Electrical Engineer a welcome visitor during the past year."

MECHANICAL

The Comparative Cost of Steam and Electric Power.—V.

BY IRVING A. TAYLOR.

ELECTRIC POWER.

THE commercial efficiencies of the electric motors may be taken as follows:

CASE I.—10 h. p. motor, 83 per cent.; 25 h. p. motor, 88 per cent.; 50 h. p. motor, 90 per cent.; 100 h. p. motor, 91 per cent.

CASE II.—10 h. p. motor, at 100 per cent of load, 83 per cent.; at 80 per cent. of load, 82 per cent.; at 50 per cent. of load, 78 per cent.; at 30 per cent. of load, 70 per cent. 25 h. p. motor at 100 per cent. of load, 88 per cent.; at 80 per cent. of load, 87 per cent.; at 50 per cent. of load, 82 per cent.; at 30 per cent. of load, 75 per cent. 50 h. p. motor, at 100 per cent. of load, 90 per cent.; at 80 per cent. of load, 90 per cent.; at 50 per cent. of load, 85 per cent.; at 30 per cent. of load, 77 per cent. 100 h. p. motor, at 100 per cent. of load, 91 per cent.; at 80 per cent. of load, 91 per cent.; at 50 per cent. of load, 86 per cent.; at 30 per cent. of load, 78 per cent.

TABLE 5 A.—TOTAL YEARLY COST OF ELECTRIC CURRENT.

CASE I.

H. P. of motor	10	25	50	100
B. H. P. H. yearly output	30,800	77,000	154,000	308,000
Efficiency of motor	.83	.88	.90	.91
E. H. P. H. yearly input	37,100	87,500	171,000	338,500
Cost per E. H. P. H.	$.03	$.03	$.03	$.03
Cost of yearly current	$1,113	$2,625	$5,130	$10,155

CASE III.—10 h. p. motor, at 100 per cent. of load, 83 per cent.; at 40 per cent. of load, 74 per cent.; at 15 per cent. of load, 61 per cent.; at 10 per cent. of load, 54 per cent. 25 h. p. motor, at 100 per cent. of load, 88 per cent.; at 40 per cent. of load, 79 per cent.; at 15 per cent. of load, 64 per cent.; at 10 per cent. of load, 58 per cent. 50 h. p. motor, at 100 per cent. of load, 90 per cent.; at 40 per cent. of load, 82 per cent.; at 15 per cent. of load, 67 per cent.; at 10 per cent. of load, 60 per cent. 100 h. p. motor, at 100 per cent., 91 per cent.; at 40 per cent, 82 per cent.; at 15 per cent., 67 per cent.; at 10 per cent. of load, 60 per cent.

TABLE 5 B.—TOTAL YEARLY COST OF ELECTRIC CURRENT.

CASE II.

10 H. P. MOTOR.				
B. H. P. output	3	5	8	
Efficiency of motor	.70	.78	.82	
E. H. P. input	4.28	6.41	9.76	
Hours per day at above rate	5	3	2	
E. H. P. H. per year				18,510
Cost of yearly current at $.048 per E. H. P. H				$888
25 H. P. MOTOR.				
B. H. P. output	7.5	12.5	20	
Efficiency of motor	.75	.82	.87	
E. H. P. input	10	15.25	23	
Hours per day at above rate	5	3	2	
E. H. P. H. per year				43,650
Cost of yearly current at $.03 per E. H. P. H				$1,309
50 H. P. MOTOR.				
B. H. P. output	15	25	40	
Efficiency of motor	.77	.85	.90	
E. H. P. input	19.5	29.4	44.5	
Hours per day at above rate	5	3	2	
E. H. P. H. per year				84,600
Cost of yearly current at $.03 per E. H. P. H				$2,538
100 H. P. MOTOR.				
B. H. P. output	30	50	80	
Efficiency of motor	.78	.86	.91	
E. H. P. input	38.5	58.1	87.9	
Hours per day at above rate.	5	3	2	
E. H. P. H. per year				167,000
Cost of yearly current at $.03 per E. H. P. H				$5,010

The expense rates per year will be as follows: Insurance, 1 per cent. The cost of rent for the space occupied will often be nothing, as an electric motor cannot in any sense be considered a nuisance; but in those cases where it should be included, it will seldom be more than the following amounts: 10 h. p. motor, $15 per year; 25 h. p. motor, $37.50 per year; 50 h. p. motor, $75 per year; 100 h. p. motor, $150 per year. Interest on plant will be taken at 6 per cent., and the depreciation and repair account at 8 per cent.

Attendance, 10 and 25 h. p. motors, $16; 50 and 100 h. p. motors, $21.

Supplies, 10 and 25 h. p. motors, $10; 50 and 100 h. p. motors, $15.

The following may be taken as the cost of motors, set and substantially wired: 10 h. p. motor, $315; 25 h. p. motor, $525; 50 h. p. motor, $875; 100 h. p. motor, $1,700.

TABLE 5 C.—TOTAL YEARLY COST OF ELECTRIC CURRENT.

CASE III.

10 H. P. MOTOR.				
B. H. P. output	1	1.5	4	
Efficiency of motor	.54	.61	.74	
E. H. P. input	1.85	2.46	5.41	
Hours per day at above rate	4	4	2	
E. H. P. H. per year				8,642
Cost of yearly current at $.054 per E. H. P. H				$467
25 H. P. MOTOR.				
B. H. P. output	2.5	3.75	10	
Efficiency of motor	.58	.64	.79	
E. H. P. input	4.31	5.87	12.67	
Hours per day at above rate	4	4	2	
E. H. P. H. per year				20,346
Cost of yearly current at $.048 per E. H. P. H				$977
50 H. P. MOTOR.				
B. H. P. output	5	7.5	20	
Efficiency of motor	.60	.67	.82	
E. H. P. input	8.33	11.2	24.4	
Hours per day at above rate	4	4	2	
E. H. P. H. per year				39,098
Cost of yearly current at $.03 per E. H. P. H				$1,173
100 H. P. MOTOR.				
B. H. P. output	10	15	40	
Efficiency of motor	.60	.67	.82	
E. H. P. input	16.67	22.4	48.8	
Hours per day at above rate	4	4	2	
E. H. P. H. per year				78,195
Cost of yearly current at $.03 per E. H. P. H				$2,346

Cost of current in cents per electrical h. p. hour: 8,400 to 12,000 h. p. h. consumption per year, 5.4 cents; 12,000 to 24,000 h. p. h. consumption per year, 4.8 cents; 24,000 to 36,000 h. p. h. consumption per year, 4 cents; 36,000 or more h. p. h. consumption per year, 3 cents.

This item of cost of current is the main one in the electric power account, and is somewhat subject to variation in different localities. In large cities, where the peak of the station load curve occurs after 5.30, or especially after 6 p. m., the above prices, or even a trifle lower, will probably obtain.

TABLE 6.—COST OF ELECTRIC POWER.

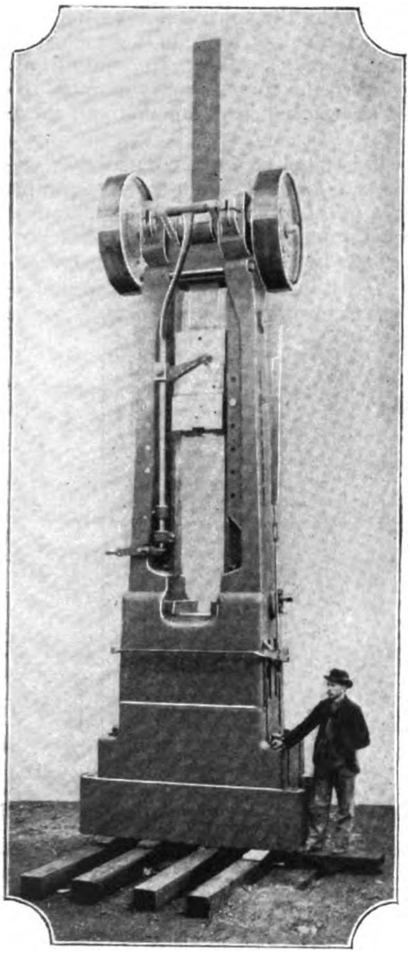
H. P. of motor	10	25	50	100
Plant cost	$315.	$525.	$875.	$1,700
Insurance	3.15	5.25	8.75	17
Rent	15.	22.50	35.	60
Interest	18.90	31.50	52.50	102
Depreciation and repairs	25.20	42.	70.	136
Attendance	16.	16.	21.	21
Supplies	10.	10.	15.	15
Total fixed charges	88.25	127.25	202.25	351
CASE I.				
Total fixed charges	$88	$127	$202	$351
Cost of current	1,113	2,625	5,130	10,155
Total yearly cost	1,201	2,752	5,332	10,506
B. H. P. H. per year	30,800	77,000	154,000	308,000
Cost, cents per B. H. P. H	3.9	3.58	3.46	3.41
CASE II.				
Total fixed charges	$88	$127	$202	$351
Cost of current	888	1,309	2,538	5,010
Total yearly cost	976	1,436	2,740	5,361
B. H. P. H. per year	14,168	35,420	70,840	141,680
Cost, cents per B. H. P. H	6.9	4.06	3.87	3.79
CASE III.				
Total fixed charges	$88	$127	$202	$351
Cost of current	467	977	1,173	2,346
Total yearly cost	555	1,104	1,375	2,697
B. H. P. H. per year	5,544	13,860	27,720	55,440
Cost, cents per B. H. P. H	10.02	7.98	4.96	4.87

Even in those cases where the station load curve is unfavorable the motor load holds so nearly steady for such a large number of hours per day that it is a very remunerative one, and though the cost of current will probably be somewhat greater, it should not be very much so. Taking the average motor efficiency over a large range of loading at 75 per cent., the effect of a variation in either direction of the cost of current will be to make the total cost per brake h. p. hour vary in the same direction, and at 1⅓ times the rate; that is, for every cent increase or decrease in the cost of current per electrical h. p. hour the cost of power per brake h. p. hour would increase or decrease about 1⅓ cents.

The total cost of electric current in dollars per year, will

be found in Tables 5 A, B and C, and the total cost of electric power, in cents per brake h. p. hour, which is the summation of all the foregoing items of expense, is computed in Table 6.

Billings & Spencer's Largest Drop Hammer in the World.



MESSRS. BILLINGS & SPENCER, the well kown manufacturers of drop forgings, have just completed and put in use what is probably the largest drop hammer in the world. They were led to the construction of this unique tool by the need for a device that would displace a large amount of metal at a single blow.

In such articles as very large sprocket wheels, deep cup-shaped specimens having considerable metal in them, it was thought to be more economical to bring these forms to the desired shape under one or two blows with a heavy drop than to depend upon a hammer of smaller capacity and repeated blows. Besides being more economical, the former method obviates many difficulties attending the displacement of large masses of metal under repeated light blows. The hammer, therefore, marks an innovation, not only because of its magnitude, but also because of the work expected of it. Another change is in the foundation, in which every attempt has been made to secure absolute rigidity and to provide a mass practically immovable, even under the greatest stroke.

The principal dimensions of the hammer are as follows:

Weight of hammer	3,000 pounds.
Weight of base	60,000 pounds.
Total weight of base	90,000 pounds.
Size of base at bottom	45 x 90 inches.
Length of uprights	11 feet 3 inches.
Between ways on uprights	18 inches.
Height from floor to top of pulleys	16 feet 9 inches.
Total height required above floor to operate machine	23 feet
Diameter of pulleys	48 inches.
Face of pulleys	10 inches.
Distance between pulleys	48 inches.
Revolutions per minute	80
Extreme fall	6 feet 4 inches.
Shortest automatic fall	31 inches.
Bottom of casting to top of pulley	21 feet 9 inches.

The lifting rolls placed at the top of the frame are automatically operated by the hammer and may be automatically shifted to effect, at any desired point of the upward movement of the hammer, a gradual release of the rolls from the lifting board, and also to effect, at any required point in the descent of the hammer, a gradual and positive engagement of the rolls with the lifting board. The effective stroke of the hammer can also be regulated as demanded by different kinds of work. The roll shifting mechanism is automatically held in its open position, and is released by the descending movement of the hammer so as to bring the rolls in engagement with the lifting board.

One of the most interesting features of this tool is the foundation. The excavation was carried down in the hammer shop of the works, where the tool is finally to be located, until hard pan was encountered. Upon this was placed a bed of concrete measuring 9 x 5 feet and having a depth of 3 feet. The concrete was composed of three of sand, one of cement and one of broken stone. On this was built up a box formed of channels placed one above the other and having a depth of 45 inches, and measuring 4 feet 1 inch by 7 feet 10 inches. In building this foundation the method was such that before the lower bed of concrete had hardened the box was placed in position and then filled with concrete. The channels measured 15 inches in depth. Through the foundation extended tie bolts, which served to hold the lower section of the base proper of the hammer. This base is composed of three sections, weighing about 20,000 pounds each. They are held together by bolts and are prevented from sidewise movements by a groove and tongue arrangement and center pin. Between the upper surface of the concrete base and the lower surface of the lowest cast iron section is interposed a sheet of lead ¼ inch thick. This serves the purpose of insuring an even and perfect contact of every portion of these two surfaces, and acts to obviate any evil results that might occur from unequal contact, or contact only in certain portions.

The results of tests made with this new drop hammer have already proved its vast superiority.

Exhaust Steam Heating.

IN your issue of December 16 "Le Chat" seems to argue against the use of exhaust steam under all conditions. At any rate, he does not point out how existing errors could be easily overcome, so that the proprietor of a power establishment can utilize 85 per cent. of the steam he generates for heating, which he cannot utilize in his engine, and only a small part of which can be absorbed in his feed water.

"Le Chat" assumes a back pressure of 12.2 pounds per square inch in a given case, and then charges this against 25 per cent. of the power of the engine, which it has to overcome. He should point out that the pipes in the building are too small, and which, if properly proportioned, should produce a back pressure of say two pounds. That would reduce the force of his argument to a minimum, if it had any force at all. So-called back pressure on an engine is an addition of so much, be it 2 pounds or 12 pounds, to the atmosphere against which the engine must work. Did "Le Chat" ever think so far as to see that if the pressure in the boilers supplying the engine was increased by an amount equivalent to the back pressure in the heating system the engines would do the same amount of work as before, and there would be no "straining of the engine," either. And the owner's pocketbook would be strained by just the extra amount of coal that the higher pressure would require above the normal. This would be but a small item in all cases where the fitting in the building was properly constructed.

"Le Chat's" "yellow dog" argument in regard to the quality of heat supplied by the exhaust steam to the radiators shows that he is hardly aware of the fact that a given steam pressure means a certain temperature of the steam. It makes no difference whether it be "live steam" or "exhaust steam." This law holds good always. House heating is, or should be, done with low pressure. From which it follows that exhaust steam at a heating pressure of one pound or more is just as efficient as steam direct from a boiler at the same pressure.

The fair conclusion is, then, if a very little brain work is employed, that the power plant may not only heat its own feed water if desired, but may do a considerable amount of heating besides, without impairing the efficiency of the engine.

SIC 'EM.

NEWS AND NOTES

The Pfatischer Electrical Steering Gear.

ON all large Atlantic liners and warships the rudder is worked by power such as steam or hydraulic. The steering engine must be located in proximity to the rudder post so as to avoid expensive power transmitting machinery such as chains, ropes or shafting, and the starting, stopping and reversing of the rudder engine must be controlled from the bridge or pilot house, in all cases several hundred feet distant from it. The valve controlling the engine could, of course, be operated by means of shafting or ropes from the pilot house, but such mechanical transmission gears work very stiffly and require too much manual labor. To make steering very easy and more accurate electricity has been introduced of late.

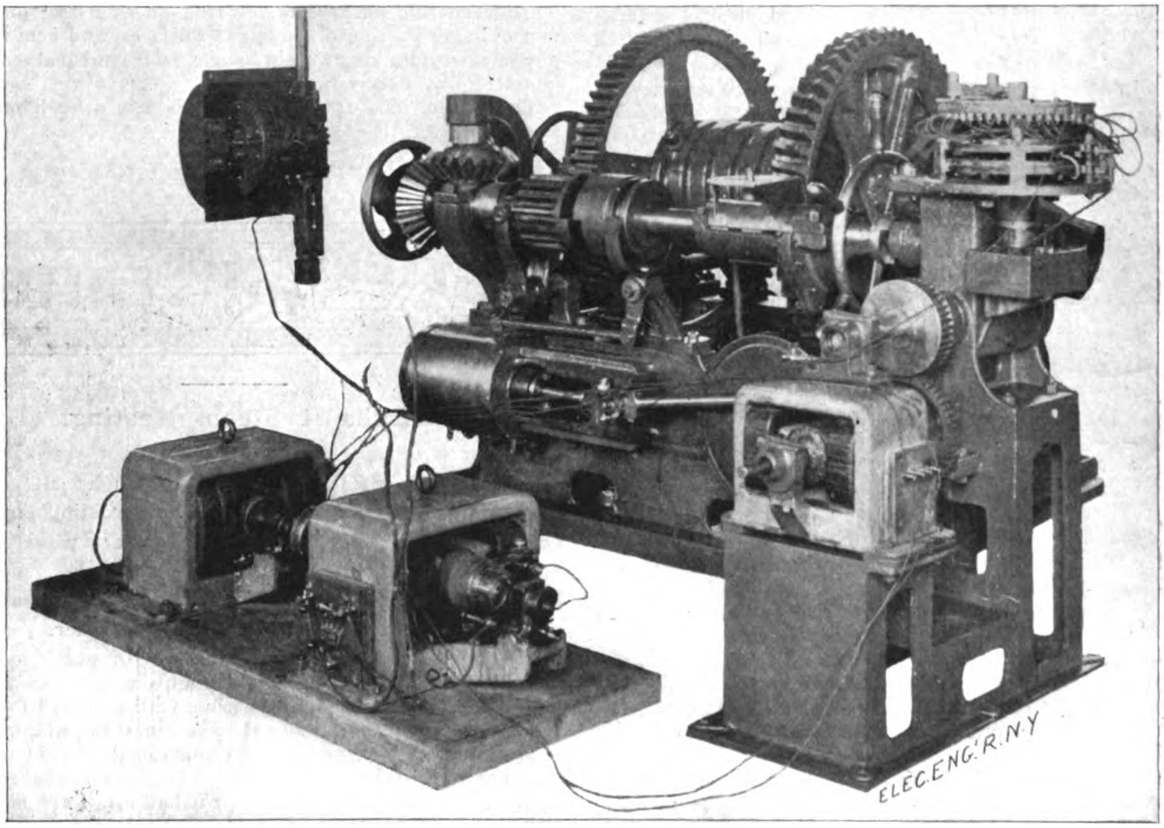
In adopting electricity for this purpose Mr. M. Pfatischer, of Philadelphia, has retained the mode of steering that has been followed for years. This method consists in turning a hand wheel which revolves a certain number of revolutions for bringing the rudder from hard a-port to hard a-starboard. The quartermaster or sailor working the steering wheel knew by giving it a certain amount of turn that his rudder would move accordingly; in adapting electricity for operating the valve of the steering engine, this modus operandi has not been changed.

Assuming now that the man operating the wheel has turned it, for instance, one-quarter of a revolution; the electric current will immediately begin to set in motion the small electric motor located at the steering engine, which motor turns the automatic shaft operating the valve of the engine. The person operating the steering wheel has no need to give any thought of closing or changing any circuit of the electric current; all that he does is to move the wheel in such direction as he desires the rudder to move.

As soon as the rudder has moved a sufficient distance corresponding to the amount of turn given to the steering wheel, the electric current is stopped automatically, therefore stopping the motor which operates the valve and which in turn stops the steering engine. The automatic control and adjustment of the electric power takes place no matter how far and in what direction the wheel is moved, the rudder following in direction and degree exactly the amount of movement of the steering wheel on bridge or pilot house.

The electric working principle of the apparatus is as follows: In turning the steering wheel through any angle an electric balance is disturbed which is only brought to equilibrium again by the rudder following to the corresponding point. No electric circuits are opened and closed in doing this and there is therefore no sparking.

The apparatus, which is illustrated in the accompanying engraving, consists of a rheostat forward and a corresponding rheostat aft at the engine, a ½ h. p. electric motor operating the valve gear and a small motor-generator. The function of the motor-generator is to produce the special current needed for the motor operating the valve. The primary current is taken from the ship's circuit and only a single wire is run to connect the two rheostats forward and aft. This single wire forms the balancing circuit, which is included in the field circuit of the motor driven generator.



THE PFATISCHER ELECTRIC STEERING GEAR ON BOARD THE U. S. BATTLESHIP IOWA.
(Built by Messrs. Williamson & Co., Philadelphia.)

Assuming now that the center arm of the forward rheostat—shown in the upper left hand corner—is moved one way or the other by the steering wheel, the electric balance is immediately disturbed, causing a small current to flow in the balancing wire. This current is transformed up to sufficient magnitude to drive the motor operating the valve and also to operate the center dial arm of the after rheostat, moving it in the same direction as the forward rheostat arm was moved. As soon as the after dial arm has reached the corresponding point the current is again balanced and the motor stops.

In transmitting the power of the small motor for operating the valve gear of the engine there has been introduced a safeguard in the form of a spiral spring device to prevent the stalling of the electric motor in case the steam engine breaks down or steam is turned off or turned on only gradually. These springs are strong enough to move the valve under

ordinary circumstances, but if occasion should arise in which the valve sticks, the engine breaks down or does not run at the speed to which the motor tries to make it travel, the power given out by the motor would then enter the springs and as fast as the engine runs the springs come back to their normal position.

If the valve does not start, the springs can be compressed, allowing the motor to travel hard over, compressing the springs; and then if the valve should start to move and the engine follow up, the springs would come back to the normal position as soon as the engine has reached the corresponding position to which the wheel in the pilot house is placed.

This electric steering apparatus illustrated is built by Messrs. Williamson Bros., engineers, of Philadelphia, and has been introduced on the United States battleship Iowa and on the monitor Miantonomoh, as well as on several Atlantic liners. The lowering of the records of several of the latter is acknowledged to be due to the use of this steering apparatus, which enables the vessels to be kept more accurately to their course than was possible by the older method.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued December 28, 1897.

Alarms and Signals:—

ELECTRICAL SIGNAL BELL FOR STREET CARS. J. P. Orr, Pittsburg, and T. F. Galvin, McKeesport, Pa., 596,085. Filed Aug. 3, 1896. Operated by electromagnets and automatically controlled.

SIGNALING CIRCUIT FOR FIRE AND POLICE SYSTEMS. A. Barrett, Kansas City, Mo., 596,134. Filed Sept. 9, 1897. Emergency calls are transmitted over the second wire, and the two wires are used as a telephonic circuit.

ELECTRICAL SIGNALING SYSTEM. J. P. Buchanan, Boston, Mass., 596,201. Filed Dec. 27, 1893. Block signal system designed to be operated by passing trains.

ELECTRIC SIGNALING SYSTEM. A. J. Wilson, Port Chester, N. Y., 596,226. Filed Dec. 21, 1895. Block signal system for railroads.

FIRE TELEGRAPH REPEATER. F. S. Skelton, Newton, Mass., 596,250. Filed July 3, 1893. Employs a supplementary battery and suitable contact devices connected to the several circuits for connecting the supplementary battery in circuits successively and momentarily.

ELECTRIC CALL BOX SYSTEM. W. T. Budds, Charleston, S. C., 596,356. Filed July 14, 1897. Details of construction.

MAGNETO ELECTRIC SIGNALING APPARATUS. A. S. Williams, Newton, Mass., 596,418. Filed June 5, 1897. Combines with the field magnet and armature, a key and a motor-spring adapted to successively move the armature in opposite directions, and a detaining device controlling and acting to delay the operation of the spring.

ANNUNCIATOR. A. D. Neale, Kittanning, Pa., 596,426. Filed March 17, 1897. Adapted to indicate a telephone call, an automatic drop-annunciator being released so that if the person called is absent the annunciator will inform him of such call upon his return.

SIGNALING CIRCUIT. J. J. O'Connell, Chicago, Ill., 11,645. Reissued. Filed March 3, 1896. Comprises a system in which the signal sending appliances at one station when actuated remain in their working position until the attendant at the other station takes proper action in response thereto.

Conductors, Conduits and Insulators:—

UNDERGROUND JUNCTION BOX FOR ELECTRIC CONDUCTORS. W. F. Bossert, Utica, N. Y., 596,229. Filed Feb. 17, 1897. Consists of a body portion, an insulating bushing held therein, a cap, an insulator bushing held therein and an elastic packing between the adjacent ends of the bushings.

Dynamos and Motors:—

SECURING DEVICE FOR COVERS OF DYNAMO ELECTRIC MACHINES. N. C. Bassett, Lynn, Mass., 596,135. Filed March 27, 1897. Designed for railway motors.

ARMATURE WINDING AND COIL. A. F. Batchelder, Schenectady, N. Y., 596,136. Filed Sept. 15, 1897. Embodies a coil having the sides to be disposed on the armature face united at least at one end by three end portions, two of which are involutes offset from one another, and the third a spiral.

DETACHABLE LAMINATED POLE PIECE FOR DYNAMO ELECTRIC MACHINES. H. Geisenhoner, Schenectady, N. Y., 596,152. Filed Oct. 11, 1897. Comprises a support provided with slots extending parallel to the shaft of the machine, laminated detachable pole pieces having projections inserted in the slots and held therein by expansion.

FOUNDATION FOR GENERATOR FRAMES. S. H. Short, Cleveland, O., 596,280. Filed March 13, 1897. Masonry foundations for large generator frames.

DYNAMO ELECTRIC MACHINE. P. W. Power, Pittsfield, Mass., 596,306. Filed Feb. 12, 1896. Comprises a rotating inductor having laminated polar projections separately fastened to the inductor core by dovetail fastenings.

Electro-Metallurgy:—

PROCESS OF AND APPARATUS FOR EXTRACTING METALS FROM ORES. W. E. Inglis, Mount Vernon, N. Y., 596,458. Filed April 20, 1896. A process of extracting tin from a refractory ore, consisting in liberating the sodium from a fused sodium compound, by the action of an electric current, and causing the freed nascent sodium to separate the tin without fusing it.

Measurements:—

INDUCTION WATTMETER. E. Thomson, Swampscott, and W. H. Pratt, Lynn, Mass., 596,190. Filed Sept. 7, 1897. Designed for single phase alternating current circuits. Details of construction.

ELECTRIC CURRENT METER. R. P. Wilson, London, England, 596,283. Filed March 24, 1897. Consists of a device by which current used at different periods of a day may be separately metered and automatically registered.

Miscellaneous:—

APPARATUS FOR ELECTROLYTICALLY PRODUCING ALKALIS. J. Hargreaves, Widnes, England, 596,157. Filed March 16, 1896. Provides the chamber with a boundary composed of a diaphragm impermeable as a filter in contact with a cathode of open texture, directing against the cathode a jet of steam which condenses and washes away the cathion.

ELECTRIC HEATER. H. Helberger, Munich, Germany, 596,160. Filed April 29, 1896. Comprises a body of conducting material, wire wound thereon, beads of refractory substance on the wire and a layer of insulating material outside the wire.

THERMOMETER. L. E. Hunt, Somerset, Ky., 596,162. Filed Sept. 21, 1896. A mercurial thermometer designed to close a circuit by the expansion of the mercury.

LEAD FOR ELECTRICAL SOUNDERS. J. Mohs, Brandenburg, Germany, 596,172. Filed Sept. 3, 1896. Comprises a body, a pair of contact devices, a shoe pivotally connected to the front end of the body and extending beneath, and means operated by the movement of the shoe for closing a circuit.

ELECTRIC GAS-LIGHTING DEVICE. A. L. Bogart, New York, and Le Roy S. White, Waterbury, Conn., 596,236. Filed May 7, 1897. Designed for Welsbach burners.

ELECTRIC BICYCLE. H. W. Libbey, Boston, Mass., 596,272. Filed Nov. 8, 1895. Propelled by a motor the current for which is supplied from primary batteries carried on the bicycle.

ELECTRIC BICYCLE. H. W. Libbey, Boston, Mass., 596,273. Filed Dec. 14, 1895. Similar to above.

ELECTRIC BICYCLE. H. W. Libbey, Boston, Mass., 596,274. Filed Dec. 14, 1895. Similar to above.

Railways and Appliances:—

ARRANGEMENT FOR PREVENTING ACCIDENTS ON RAILWAYS. H. Biermann, Breslau, Germany, 596,047. Filed May 21, 1897. Employs forked frames provided with rollers and surrounding the wheels-axles and engaging with the rails in case of wheel, axle or spring breaking with an electric circuit in the train and connected with safety and alarm apparatuses.

ELECTRIC RAILWAY. E. C. Crocker, Bridgeport, Conn., 596,054. Filed April 23, 1897. Comprises a supply conductor, a third rail consisting of insulated sections, and a power collector carried by the car.

TROLLEY. A. Travaglili, Philadelphia, Pa., 596,131. Filed Nov. 13, 1896. Designed for double track roads having a single conductor wire.

ELECTRIC RAILWAY. W. B. Potter, Schenectady, N. Y., 596,182. Filed Nov. 18, 1896. Third rail system.

TROLLEY BASE CUSHION. W. G. Wagenhals, Dayton, O., 596,193. Filed July 23, 1897. Comprises two pairs of helical springs having spiral grooved spring bushings and a trolley base mounted on and above the springs.

RAIL-BOND. F. H. Daniels, Worcester, Mass., 596,202. Filed July 26, 1897. Comprises a rod, each end of which is reduced and provided with a tubular terminal.

TROLLEY RAIL. W. A. P. Willard, Jr., Hull, Mass., 596,224. Filed Feb. 12, 1897. Third rail, comprising a conductor, a truck normally insulated therefrom and capable of a limited longitudinal movement into electric contact therewith and a contact-rail supported upon the truck and brought into circuit with the conductor.

TROLLEY RAIL FOR ELECTRIC ROADS. W. A. P. Willard, Jr., Hull, Mass., 596,225. Filed March 5, 1897. Similar to above.

TAKE-UP FOR CONTROLLING SLACK OR TROLLEY ROPES. H. E. Adt, New Haven, Conn., 596,439. Filed May 10, 1897. Details of construction.

TROLLEY FOR ELECTRIC RAILWAY CARS. E. Cone, Chicago, Ill., 596,456. Filed Dec. 11, 1896. Employs V-shaped guards at each side of the trolley wheel and means for holding one of the wings of the guards in substantially vertical position, above the surface of the trolley wheel.

Regulation:—

PHASE REGULATOR. C. P. Steinmetz, Lynn, and W. Rice, Swampscott, Mass., 595,186. Filed Sept. 9, 1893. An electrodynamic phase controller having inducing and induced members, means for increasing the self-induction of the induced member, and a source of power driving the controller above its normal speed.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRICAL PROTECTIVE APPLIANCE. A. S. Williams, Newton, Mass., 596,197. Filed August 26, 1897. Designed for electromagnetic apparatus.

REMOVABLE FUSE HOLDER. J. T. Hunt, New York, 596,209. Filed July 12, 1897. Details of construction.

QUICK BREAK SWITCH. R. C. Demary, Buffalo, N. Y., 596,363. Filed Aug. 2, 1897. Details of construction.

COMBINED MANUAL AND AUTOMATIC SWITCH. R. L. Hailey, New York, 596,457. Filed Sept. 27, 1897. Details of construction.

Telegraphs:—

PRINTING TELEGRAPH. B. A. Brooks, Brooklyn, N. Y., 596,320. Filed August 11, 1894. Details of construction.

Telephones:—

TELEPHONING FROM CARS IN MOTION. H. W. Libbey, Boston, Mass., 596,276. Filed April 6, 1897. Embodies two electric rails carried by springs secured to the web of the rail, a wheel having rings of conducting material in or on its flange, trolleys running upon the rings in combination with a telephone and connections between the telephone and trolley.

CAXTON POWER BUILDING is a new enterprise for Cleveland, O. It will be equipped throughout with electricity and Mr. Wilson M. Day, of the Cleveland Printing and Publishing Co., is one of the active spirits in the enterprise.

SOCIETY & CLUB NOTES

NORTHWESTERN ELECTRICAL ASSOCIATION meets on January 19 and following days at the Hotel Pfister, Milwaukee, Wis.

THE STOCK MARKET

Year Opening Well.

The corner of the old year had barely been turned before the prices of bonds and stocks began to advance briskly, and at the present writing there is a marked display of confidence throughout the entire field of American investment. Railroad earnings are good, bank clearings again show gains, there is growing activity in almost every line of trade and industry, and business failures are both fewer and smaller, as compared with the years of distress. A remarkable feature of trade is the continued large demand for goods to export, each week seeming to find some new article that can be pushed with advantage abroad. In the engineering fields of work, there is notable activity and inquiry; while the big demand for iron and steel shows that construction of all kinds is going on or contemplated, upon the largest scale.

During the past week 58,252 shares of Western Union were sold up to 93⅛. On sales of 23,668 shares General Electric rose to 36⅝; while in Boston, American Bell Telephone stood around 265 on sales of 540 shares. There were rumors current of a proposed closer alliance between the Western Union and Postal Telegraph interests. There was considerable stir in Manhattan Elevated due to reports of a coming change to electricity.

TRADE NOTES & NOVELTIES

Magnolia Anti Friction Metal and Its Imitations.

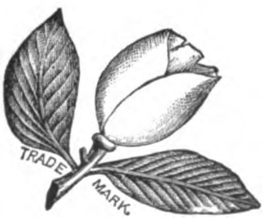
THE MAGNOLIA METAL COMPANY, whose trade extends to every part of the United States and Canada and to every civilized country in the world, have during the last two or three years had numerous suits with parties infringing their trade marks and patents. An injunction was granted on December 15, last, by Lord Chief Justice Russell in the Queen's Bench Division of the High Court of Justice, London, England, enjoining the Tandem Smelting Syndicate, Ltd., and restraining them from passing off their metal for Magnolia metal, it being made up so as to counterfeit Magnolia metal.

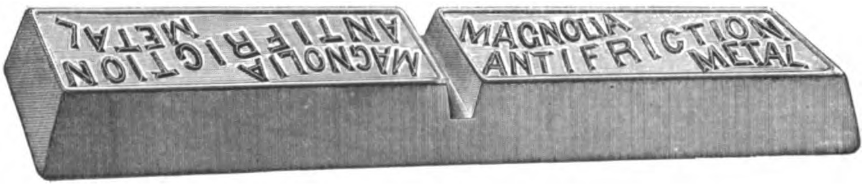
A few months ago the Globe Engineering Company, Ltd., of Manchester (now in liquidation), shipped a quantity of metal to a firm in South Africa that had ordered Magnolia metal. The metal sent to fill this order was made up into ingots as near as possible to represent the well known ingots of Magnolia anti-friction metal. They bore the words "Magnolia Anti-Friction Metal," but the trade mark, the magnolia flower, and the words "patented June 3, 1890" were not imprinted upon them. The purchaser brought an action in the High Court of Justice, at the Manchester Assizes, against the sellers, and judgment was given in his favor by the arbitrator to whom the matter was referred.

The Magnolia Metal Company has called our attention to the above and desires to warn the public against fraudulent imitations.

Genuine Magnolia anti-friction metal is made up into bars of which the accompanying engraving is a facsimile, and the trade mark, a magnolia flower, and name are always stamped on bars and boxes; and besides this the words "Patented June 3, 1890," and "Manufactured in U. S." are stamped on the under side of each bar.

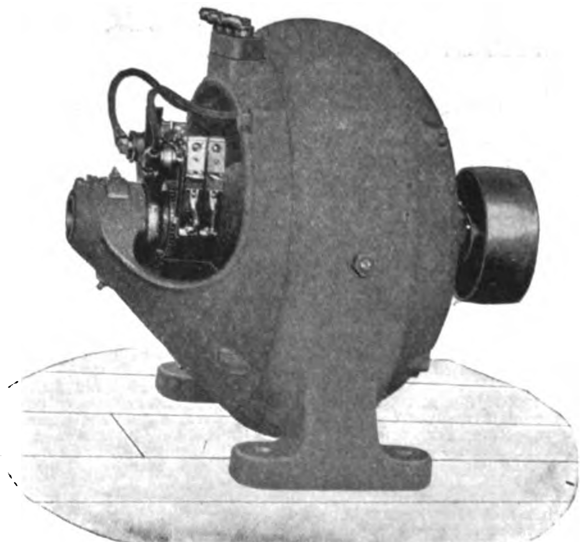
The Magnolia Metal Company, of 266 West street, New York, advise us that similar frauds are being committed in this country at this time, and they offer one thousand dollars reward to any party causing the arrest and conviction of any individual or firm infringing their trademarks or patents.





New General Electric Ironclad Bipolar Machines.

THE smaller sizes of the slow and moderate speed generators now being built by the General Electric Company, are of the bipolar type and while embodying the same style of construction as the four pole machines, differ greatly in appearance. They are known as I. B. (iron-clad bipolar) machines, and, as will be seen, have a field frame completely surrounding, and protecting from mechanical injury, both field spools and armature.



NEW G. E. IRONCLAD BIPOLAR MACHINE.

The small size of these generators, their compactness, and the small floor space occupied render them peculiarly suitable for small isolated plants, and being adapted for direct driving they make neat sets for small yacht and launch plants. The slow speed I. B. generators range in capacity from ¾ k. w. to 4½ k. w., the moderate speed from 1½ k. w. to 7½ k. w. All are wound for 125, 250, and 500 volts.

THE GENERAL ELECTRIC COMPANY desire to advise all holders of their complete Incandescent Lamp Catalogue No. 1012, of an error in the appendix, in the table on page 58. The figures .662 in the column "Life Factors" should be .562. They kindly request that all holders of the catalogue make this correction.

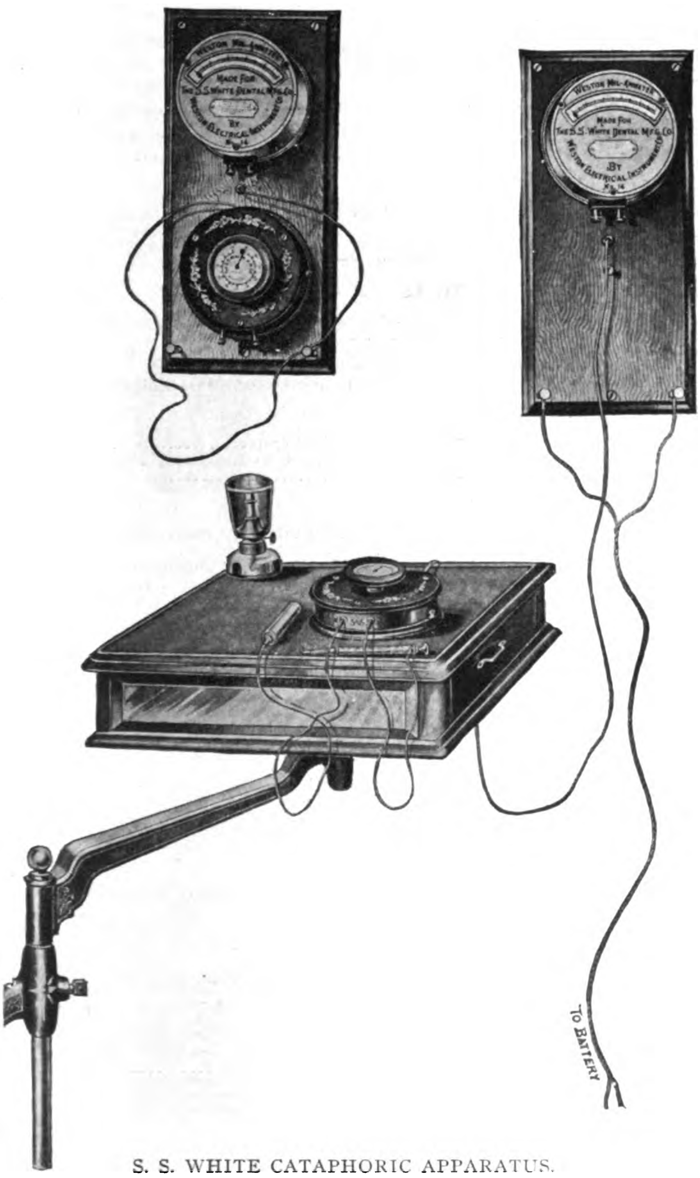
The S. S. White Dental Cataphoric Apparatus.

CATAPHORESIS as applied to dentistry has come to stay, and now no dentist can consider himself fully equipped for his work without a proper cataphoric outfit. Always abreast of the times, the S. S. White Dental Manufacturing Company has, after long experimentation, brought out a line of dental cataphoric apparatus which they have, by actual use, proved to be fully adequate to the purpose for which it was designed.

This apparatus consists of a battery, a current controller, cataphoric electrodes and a current measuring instrument.

The battery employed is a set of 18 or 24 dry cells, mounted in a neat varnished oak box. Dry cells have been selected on account of their cleanliness, and also for the reason that the amount of current required in cataphoresis is so small that a set of cells will last for one or two years even with the largest office practice.

One of the outfits is shown in the accompanying engraving,



S. S. WHITE CATAPHORIC APPARATUS.

the current controller or regulating rheostat being shown resting on the bracket table. This rheostat is, in a measure, the most important part of the outfit as the current must be applied to the patient by very small increments. In the present instance graphite has been selected as the resistance material, and prolonged tests by the S. S. White Company have demonstrated the permanence of the action of this type of rheostat.

The controller, shown on the bracket table, consists of a polished wood cylindrical case with black enameled slate top 5½ inches in diameter and 1½ inches high. The regulating wheel is raised 1 inch above this. Four cone socket connecting posts receive the cords from the battery and electrodes, and a switch on the side of the case cuts off the entire current. This latter is small and neat, and supersedes the separate switch previously used on the battery cord.

The regulating wheel is 2⅜ inches in diameter, and contains the scale protected by a crystal cover. The scale is graduated into 100 equal parts, which permits the conditions of an experiment to be exactly repeated, but does not give any electrical data. When desired, the scale is graduated to read the volts on the patient's circuit, and by a new method this holds good independently of the number of cells in circuit. Following the most approved practice the shunt method of connecting up the resistance has been adopted.

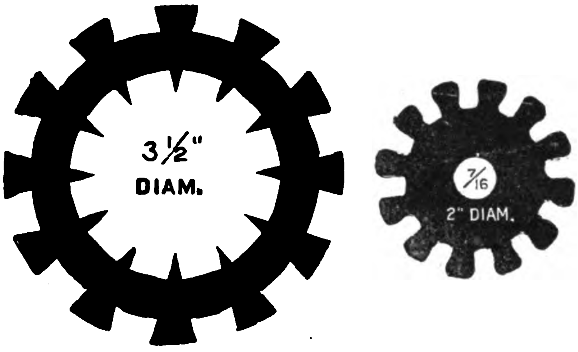
For measuring the current the Weston milliammeters have been adopted, which are specially made for the purpose.

The meters, one of which is shown hung up in the engraving, are about 5½ inches in diameter and 2⅞ inches high. They read five milliamperes divided to twentieths of a milliampere, and their movement is so delicate that an increase or decrease of one-hundredth of a milliampere can be detected. The outfit also comprises the necessary electrodes.

With the apparatus described, the dentist is in a position to treat his patient intelligently with the absolute knowledge, at every instant, of the condition of the treatment.

Mianus Armature Discs.

MANY who make dynamos and motors do not care to get out dies for making armature punchings. The Mianus Electric Company, of Mianus, Conn., make several sizes and carry them in stock, especially the small sizes of toothed



MIANUS PUNCHED ARMATURE DISCS.

punchings such as 1¾, 2, 3, 3½ and 4 inches. They also make larger sizes to order, both plain and toothed, from special soft iron rolled for the purpose. Our illustration shows two of the styles of discs furnished by the company.

The Cherry Electrical Instruments.

TWO valuable but inexpensive testing instruments for both students and practical electricians are now being manufactured and sold by the Cherry Electric Works, 25 and 27 Third avenue, New York, at the price of $1.50 each. These instruments are a voltmeter reading from 0 to 10 volts, and an ammeter reading from 0 to 10 amperes. They are not toys because sold at a low price, but are scientifically constructed instruments. For amateurs and others experimenting with batteries, dynamos, motors, or using current for any purpose and for whom the standard instruments are too expensive, these will be found to be just what is wanted. After the first of January these instruments will be constructed in hardwood cases which give them a very handsome appearance.

THE U. S. ELECTRICAL SUPPLY CO. have now moved from 120 Liberty street, to their new offices and factory in the Lexington Building, at 25th street and Lexington avenue, where they will manufacture apparatus for wireless telegraphy, X-ray apparatus, and Clarke's new combined stereopticon and vitascope, which is a model of compactness and operates without any of the noise which has been one of the principal objections to such apparatus in general.

ADVERTISERS' HINTS

THE PRATT & WHITNEY COMPANY, Hartford, Conn., advertise vertical and horizontal adjustable multispindle drilling machines.

THE CHERRY ELECTRIC WORKS, 25 Third avenue, New York, offer direct reading ammeters or voltmeters reading from 0 to 10 at $1.50, and reading from 0 to 25 at $5.00 each.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, New York, have something to say on the way the dollars get away and how it may be prevented.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, will send a sample two ounce box of the "Highland" soldering paste on receipt of twenty-five cents.

THE NON-POLARIZING DRY BATTERY COMPANY, 625 Broadway, New York, claim their "O. K." cell to be more efficient than the old fluid style, and cleaner, more compact and better in every way.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, advertise a new and marvellous electric cable for interior use which is said to be both fire and burglar proof.

THE SHAWMUT FUSE WIRE COMPANY, 93 Federal street, Boston, Mass., illustrate their style of fuse designed to fit the present 500 volt fuse-blocks.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., advertise circuit breakers.

TOWNSEND & DECKER, attorneys at law, 5 Beekman street, New York, may be consulted on all matters pertaining to U. S. and foreign patents.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, have introduced a hanger-board complying with the requirements of the National Board of Fire Underwriters.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, advertise all classes of dynamos and motors for lighting and power.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., have sold the Western Union Telegraph Company 436 chloride accumulators, which it will install in its Memphis office, displacing 5,250 gravity cells.

NEW YORK NOTES.

THE GENERAL ELECTRIC COMPANY will be represented at the Northwest Electrical Association Convention at Milwaukee, by the following gentlemen from its Chicago office: Messrs. J. Scribner, R. A. Swain, P. A. Clisdell, F. N. Boyer, and Thomas Ferris, of Milwaukee. It will make an exhibit as usual at these conventions, which will consist of a full selection of wiring supplies, recording wattmeters, inclined coil instruments, new transformers, and long burning arc lamps for direct current, alternating current, railway and power circuits. Its headquarters will be in a special room at the Pfister Hotel, close to the Club Room where the meetings of the association will be held.

P. M. MOWREY & COMPANY, 318 Broadway, New York, have just issued a very neat and pretty little pamphlet devoted to their work in the Bowling Green Building, and supplemented by a long list of their public and private installations. They have a large staff, including Mr. E. H. Curtis, electrical engineer, and have a good deal of work ahead in 1898.

PHILADELPHIA NOTES

MESSRS. VALLEE BROS. & COMPANY, through their agent, Mr. D. B. Scarborough, have sold 40,000 feet of Armorite interior conduit to Wilkesbarre, Pa., parties to be used in the new Hotel Sterling now under construction there.

THE PENNSYLVANIA ELECTRIC COMPANY, of Marietta, Pa., are the happy recipients of an order for 500 telephones, complete, from one company, besides several smaller orders.

MESSRS. JOHN E. GRAYBILL & COMPANY, of York, Pa., who for several years have conducted a successful electrical supply and construction business, have recently added a well equipped machine shop, where they will manufacture switches and switchboards, rewind armatures, and do special machine work.

MR. ALFRED F. MOORE, Philadelphia, has issued for 1898 one of his handsome conspicuous calendars, with large figures which he who runs may read. It is a good thing for the office or factory.

G. F. BRUNT PORCELAIN WORKS, of East Liverpool, O., have issued one of the daintiest, prettiest sheet calendars of the season and one which will serve all through the year to keep in mind their porcelain for electrical purposes.

CONTENTS.

Department News Items will be found in advertising pages.

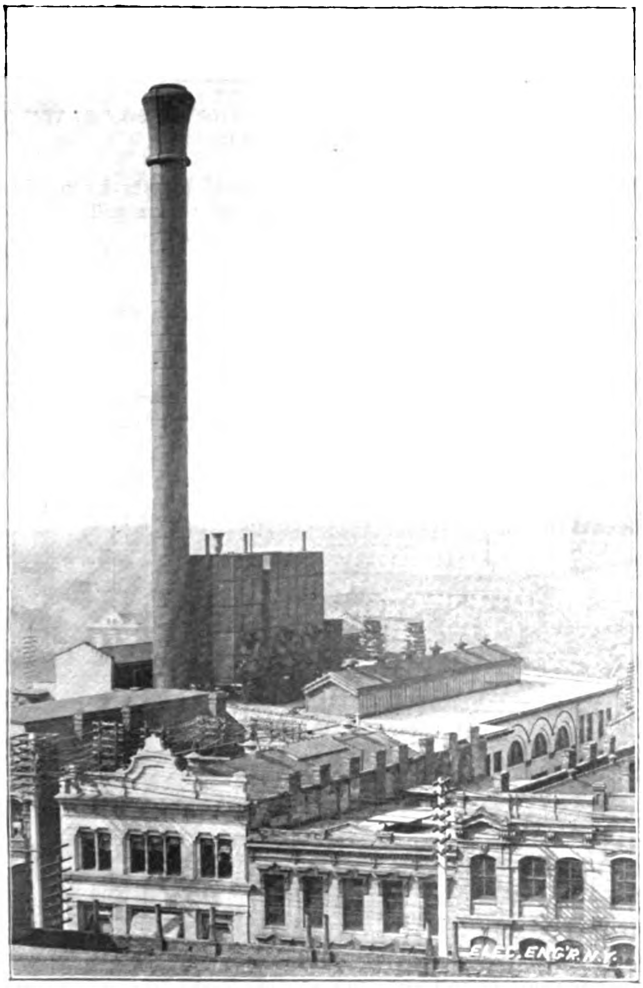
The Electrical Engineer.

Vol. XXV. JANUARY 20, 1898. No. 507.

ELECTRIC LIGHTING

The New Station of the Edison Electric Co., of New Orleans, La.

WHILE one hears of constantly increasing indust·ial activity in the South and the introduction of electric light and power in particular, it must not be supposed that electrical work is of recent advent in that section of the country. On the contrary, some of our Southern cities were among the earliest to take up the electric light, and among them was New Orleans, where a company was organized as far back as August, 1886, under the name of the Edison Electric Illuminating Co. The work of the company progressed during each succeeding year, and in 1893 a reorganization was effected, in



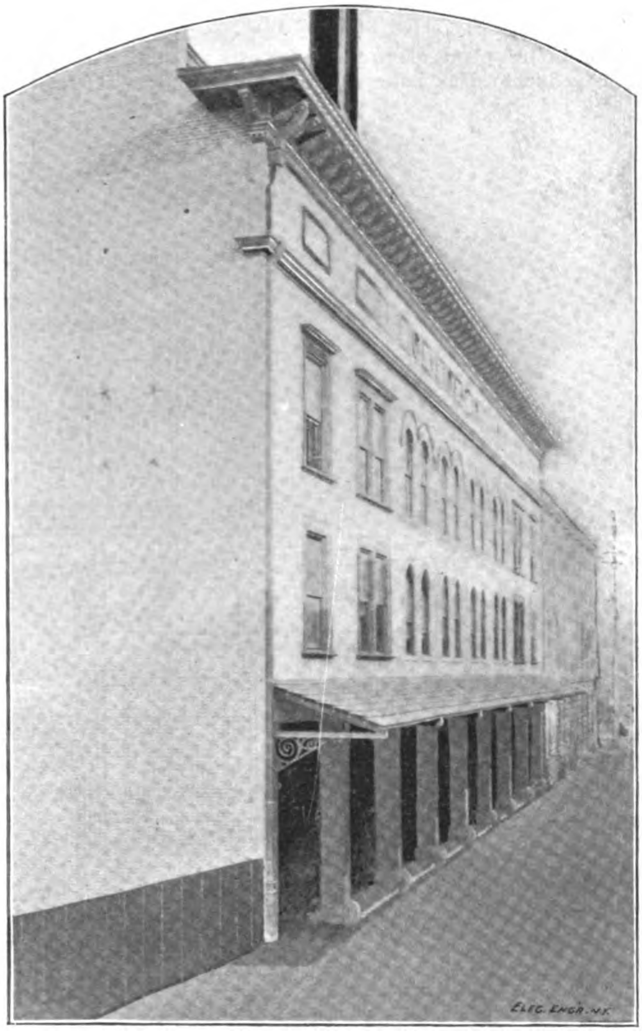
BIRD'S-EYE VIEW OF NEW STATION OF NEW ORLEANS EDISON CO.
(The view shows roof of office and station, with smoke stack and cooling towers.)

order to broaden its powers, when the present name was adopted.

The original equipment of the company naturally contained the best the art afforded at the period, but with the ever-increasing demand it became obvious some time ago, that greater economy could be effected by abandoning completely the old station apparatus and installing a modern plant throughout. The funds having been authorized for this purpose, work was begun on the new station during the early part of last year, and now the new station has begun its work with every prospect of meeting the high expectations of its projectors. The present article illustrates and describes its leading features.

THE STATION BUILDING.

The new station building is erected on a lot 138 feet long by 100 feet in depth. Owing to the nature of the soil the ground had to be piled, 933 50-foot piles being required to sustain the weight of the building and contents. After the piles had been sawed off level, 12x12 yellow pine stringers were laid on top, securely fastened to the piles by means of drift bolts.



FRONT OF THE NEW STATION OF THE NEW ORLEANS EDISON CO.

All the loose earth was then removed from around the top of the piles, and the spaces thoroughly filled in around with concrete flush to the top of the stringers. On top of the stringers and running at right angles to each other, 4x12 pecky cypress planks were laid, covering the entire area of the foundation. On the top of this timber grillage a bed of concrete three feet deep was laid. The engraving on page 74 shows the method of construction adopted.

It was found on driving the piles that at a depth of about 45 feet they met with great resistance, which on investigation was found to be a shell bank, thus insuring a perfect rest for the piles. The weight carried by each pile, including the building, coal and machinery, was calculated to be 13½ tons.

The building proper is a steel structure, the brick walls simply acting as a curtain to keep out the weather. The engraving, page 74, gives a good idea of the steel structure and

shows the coal bunkers in the boiler room and the electric crane in the engine room. The coal bunkers are carried from the roof trusses over the boiler room, and by them the load is transmitted to the steel columns of the building. The bunkers are built to carry 1,000 tons of coal. All the columns, which are of the Z-bar type, after being erected, were filled with cement mortar, one part cement and two parts sand. This has the effect of deadening the noise usually made by traveling cranes where the columns are left hollow, and helps to stiffen the columns.

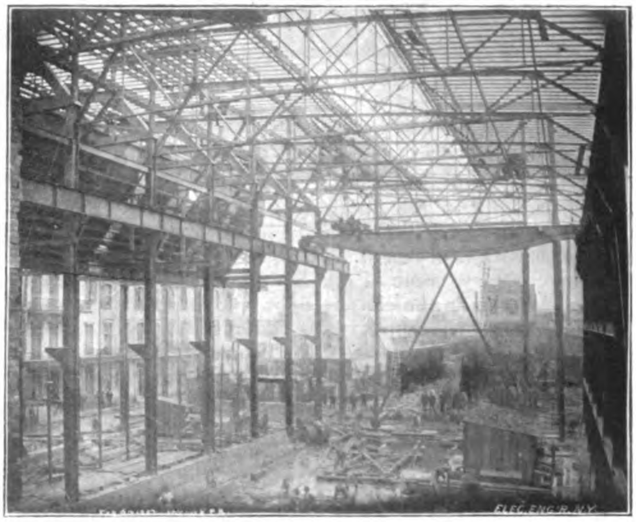
The steel work was built and erected by the Berlin Iron Bridge Company, of East Berlin, Conn. The piling and masonry work was done by James Stewart & Co., of St. Louis. The exterior of the building is finished with St. Louis pressed brick of a buff color, with terra cotta trimmings. The interior of the engine room is faced with white enamel brick for a height of 12 feet, above which it is faced with St. Louis pressed brick.

THE BOILER PLANT.

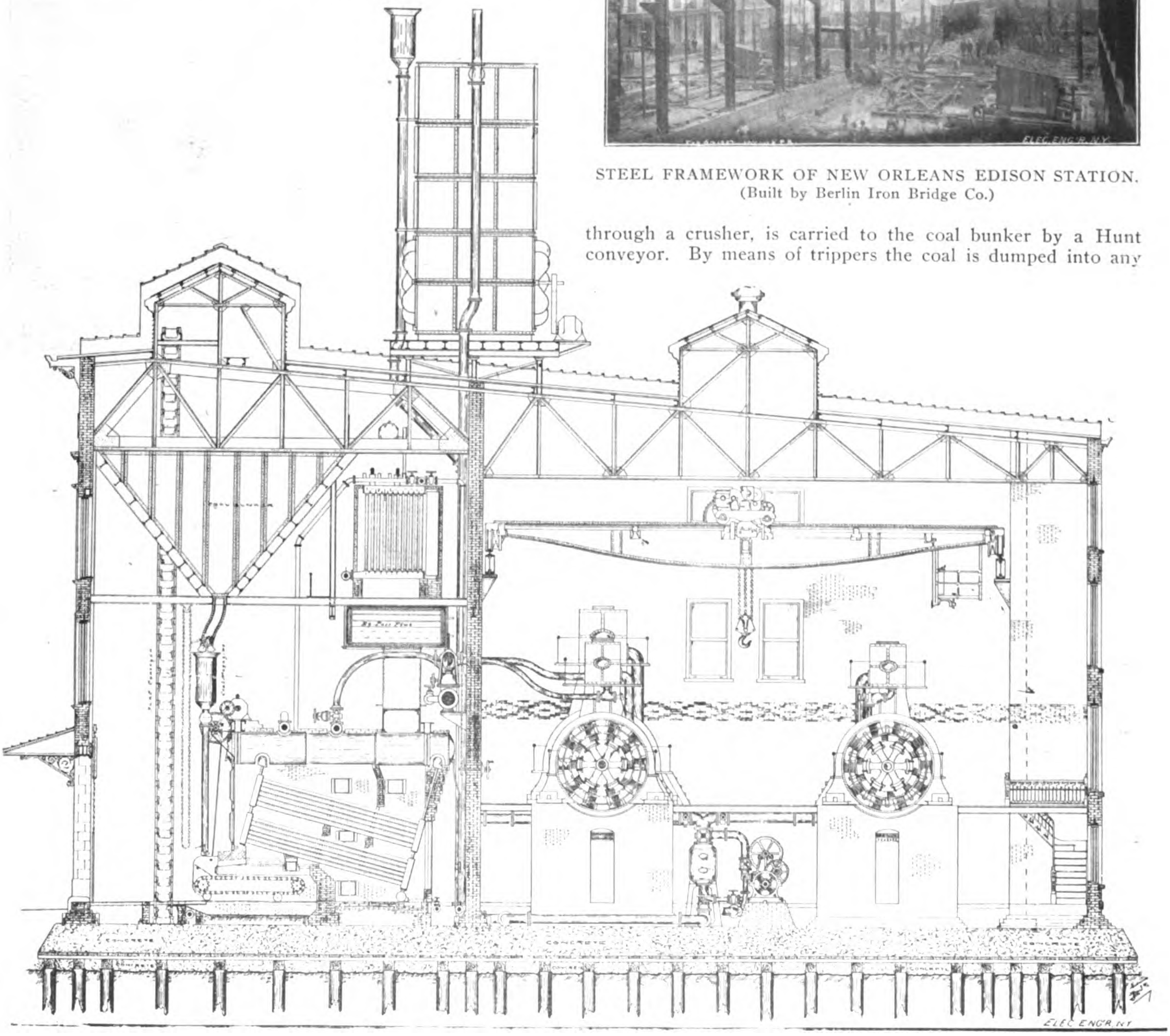
The boiler plant at present consists of four Babcock & Wilcox double deck boilers, set in two batteries. The boilers have forged steel headers, and are built for a working pressure of 180 pounds. Each boiler is equipped with a Babcock & Wilcox chain grate stoker, having 69 square feet of grate. The boilers have a total heating surface of 16,724 square feet. The normal rating of each boiler is 500 h. p., but will develop a maximum of 750 h. p. The boilers have brick settings, the facing being white enamel brick, which enables them to be kept perfectly clean, besides making a very pretty setting.

COAL HANDLING MACHINERY, ECONOMIZERS, ETC.

The coal, which will be Alabama run of mine, after passing through a crusher, is carried to the coal bunker by a Hunt conveyor. By means of trippers the coal is dumped into any one of the five pockets of the coal bunker. From these pockets the coal is dropped in a magazine, as shown above, where an accurate weight of coal consumed by each boiler is kept. From the magazine the coal is fed into the stokers as



STEEL FRAMEWORK OF NEW ORLEANS EDISON STATION.
(Built by Berlin Iron Bridge Co.)

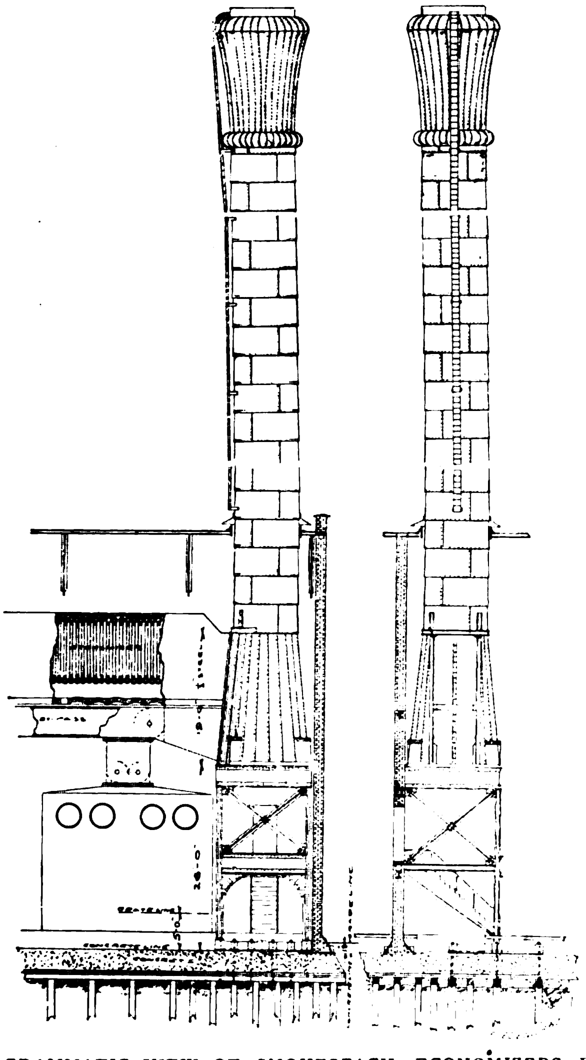


ELEVATION OF NEW ORLEANS STATION.
(Showing Engine and Dynamo Room, Boiler Room, Economizers, Condensers, Pumps, Cooling Tower, Etc.)

required. By this process there is absolutely no handling of coal except by machinery. The stokers, coal crusher and conveyor are driven independently by G. E. 1,000 motors.

Green economizers are located above the boilers, as shown in the sectional elevation opposite, and are arranged with by-pass so that they can bé cut out for cleaning or repair. They have a capacity of 2,000 h. p., and contain 8,640 square feet of heating surface. They are encased in a sectional sheet iron casing, lined with four inches of abestos instead of the usual brick setting. The iron casing was adopted for lightness and on account of accessibility and to reduce the cost of repairs. The economizer scrapers are operated by a G. E. 1,000 motor. The dampers are controlled by a Locke damper regulator.

The smoke stack, which is 200 feet high above the grate bars, is built of steel, lined with fire brick for a distance of 80



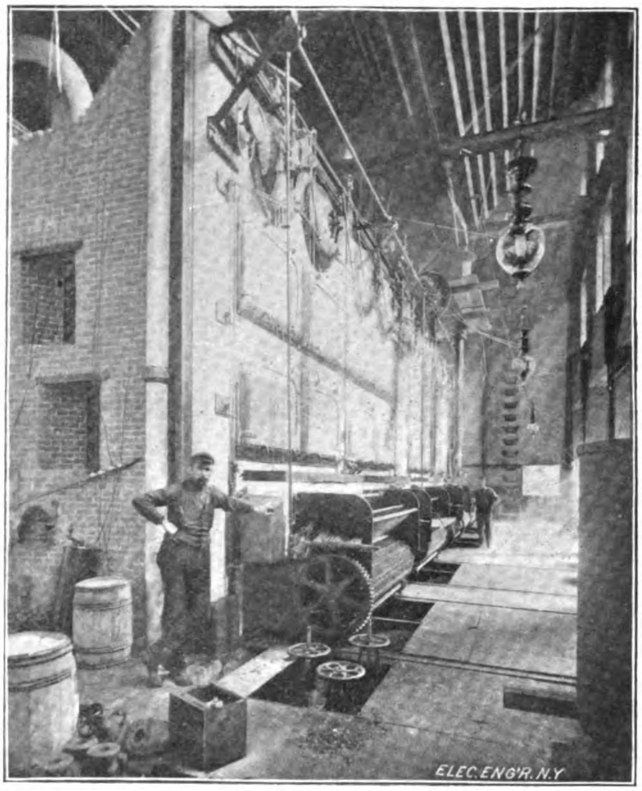
DIAGRAMMATIC VIEW OF SMOKESTACK, ECONOMIZERS, ETC.
(The stack is shown shortened.)

feet above the base. The stack is carried on a sub-foundation built of columns and securely braced, as shown on this page. Two of the columns in the center wall of the building carry half the weight of the stack, and the two other columns that carry the remaining half are fastened securely to the piling, provision being made for this when the piling foundations were put in. The stack is self-supporting and designed to withstand a wind pressure of 100 miles an hour.

The oil room is located in the boiler room, and the oil flows by gravity to the engines and pumps. The waste oil is collected in a tank in the basement and pumped back to the oil room, where it is filtered through a Turner filter. In the oil room are also located two Edminston filters for extracting the oil from the water from the hot well before entering the boilers. There is also a compressed air system for cleaning the generators, etc., an air pressure of 20 pounds being carried in the receiver, from which small pipes are led to the generators where a hose connection is made to clean the different parts of the machines. The air compressor is driven by a motor directly connected to the crank shaft.

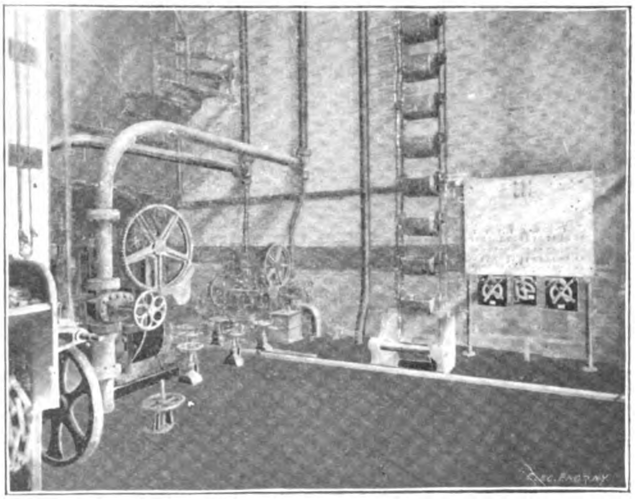
STEAM PIPING.

The steam piping, as will be seen from the plan, page 76, has been reduced to a minimum. The main header, which is built



BABCOCK & WILCOX BOILER PLANT, NEW ORLEANS EDISON STATION.

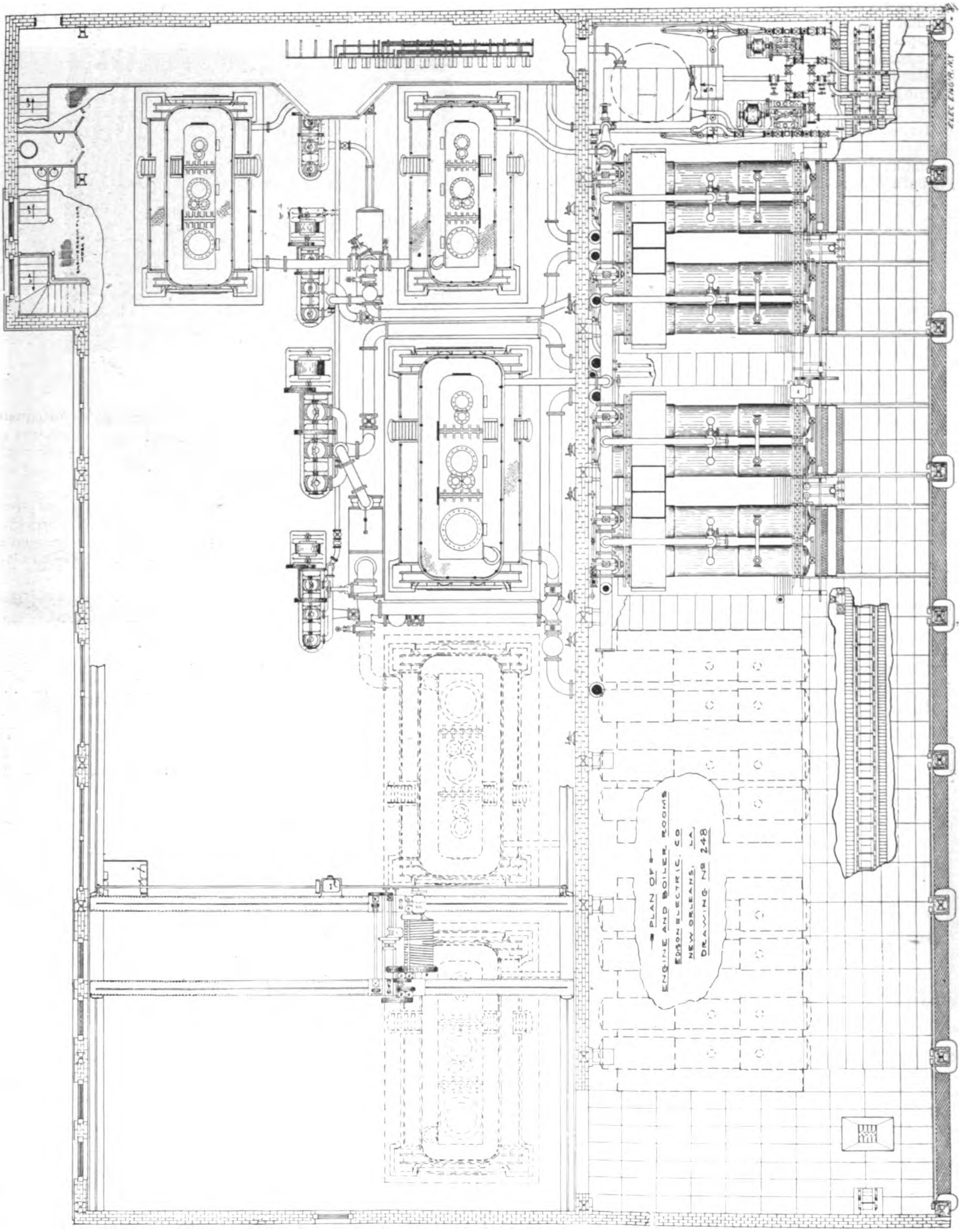
of cast steel, was made by the Penn Steel Casting & Machine Co. The use of cast steel does away with a number of joints and threads and makes a very compact and solid piece of work. The header is carried on brackets attached to the columns of the building, and rests on expansion rollers, which give ample room for expansion and contraction. The header is securely fastened in the center so that the expansion is reduced to a



CORNER OF BOILER ROOM, EDISON STATION, SHOWING PUMPS, ETC.

minimum. The connections from the boilers to the header, and from the header to the engines are copper bends, which allow of expansion and contraction. These bends and the header comprise all the live steam pipes. In the remainder of the

piping (exhaust and water) steel pipe is used with flanges peaned on. The flanges are made from steel forging, and after they are put on, the pipes are faced up so as to be true. The gaskets used throughout the entire system are corrugated



PLAN OF ENGINE AND BOILER ROOMS, NEW STATION OF NEW ORLEANS EDISON CO.

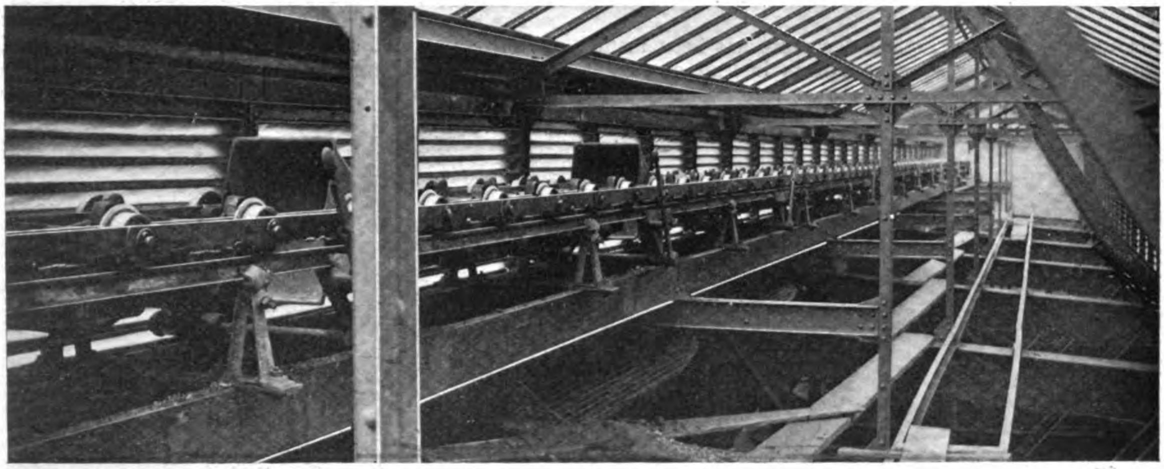
copper. The Shook, Anderson Mfg. Co., of Pittsburg, furnished and installed the piping.

THE ENGINES.

The engines, of which at the present time three are being installed, two 600 h. p. and one 1,200 h. p., are of the Williams triple expansion marine type with receivers, cylinders side by side, each acting on a separate crank with direct connected generators on either end.

The 600 h. p. engine has cylinders 14½" high pressure, 23" immediate pressure, and 37½" low pressure, by 28" stroke; speed, 150 revolutions per minute. The 1,200 h. p. has cylinders 21½" high pressure, 35" intermediate pressure, and 55½" low pressure, by 36" stroke; speed, 120 revolutions per minute. These engines give their rated power at about 25 pounds m. e. p., and are to operate condensing under 175 pounds pressure at the throttle.

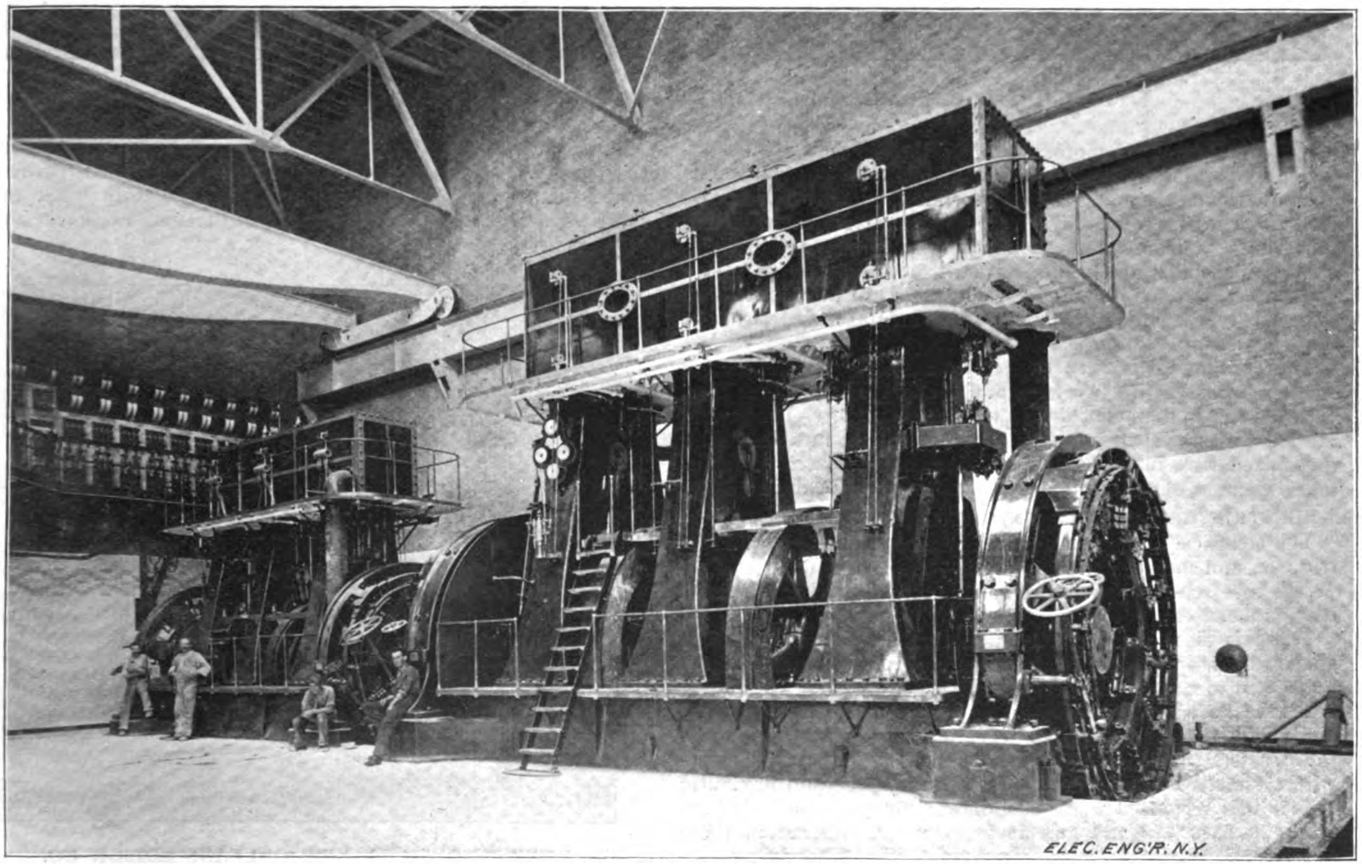
The shafts are larger than marine sizes and are provided with heavy flywheels between cranks, and are extended out each end to carry the armature. The weight of the armature and flywheel, being approximately the same, gives an even distribution of weight upon the several bearings, and the extreme rigidity of the shaft secures perfect alignment and freedom from undue straining.



HUNT COAL CONVEYOR SYSTEM, NEW ORLEANS EDISON STATION.

The valve system differs considerably from the usual marine practice. Piston valves with self-adjusting relieved packing rings are used for the high pressure cylinders. The same valves are used also in intermediate cylinders, and flat multiported valves are used for the low pressure cylinders, having separate steam and exhaust valves, driven by two eccentrics, one for steam and one for exhaust. Intermediate quarter-crank rockers are used on both low pressure valve gears also, in order to secure a wide opening with short traveling of valve. Double piston valves are used on the intermediate pressure cylinders, also on the high pressure cylinders, so as to secure small cylinder clearance with light weight of valve. Unusually large and free openings are provided for steam everywhere, and a very high mean effective pressure is maintained for any given number of expansions and consequent terminal pressures, thus insuring one of the main elements of economy in the use of steam in the steam engine. The throttle valve is of the flanged lever type and operated from the starting platform.

All cylinder cocks and their drains and by-passes are operated from the steam platform. The cylinders are provided with spring relief valves at the top and bottom, as a protection against water hammer. The receivers and the cylinders are protected with a non-conducting covering, over which there is a steel jacket held in place by bands. Steel jackets are provided for all cylinder heads, and reheating coils are placed in the receivers. These reheating coils are composed of 1¼ inch



VIEW IN ENGINE AND DYNAMO ROOM, NEW STATION OF NEW ORLEANS EDISON CO.

copper pipe. A boiler pressure of 170 pounds is admitted to all jackets and both reheaters. The general design of the engine, as will be seen on the page opposite, is massive, there being abundant strength and surface provided everywhere. The railings and posts are polished, as also are all connecting rods and all reciprocating parts.

PUMPS.

In the matter of pumps, a radical departure has been made, all pumps being driven by electric motors instead of steam. In the present installation there are two feed water pumps driven by slow speed motors, and different speeds can be obtained by varying the pressure from 230 volts to 115 volts. The air and circulating pumps are independent and are driven and controlled in the same way. The Wheeler Condenser & Engineering Co. installed the condensers and pumps, which include the installation of the Barnard cooling towers. Two condensers, of 1,200 h. p. and 2,400 h. p., are of the well known Wheeler type, while the pumps are manufactured by the Knowles Pump Works.

The cooling towers are 14 feet square by 30 feet high, the smaller tower having two fans, and the larger tower four fans, each ten feet in diameter, driven by electric motors. The towers are fed with a system of water distribution and furnished with galvanized wire mats, having sufficient cooling area to maintain a vacuum of 25 inches in the exhaust main of the engines.

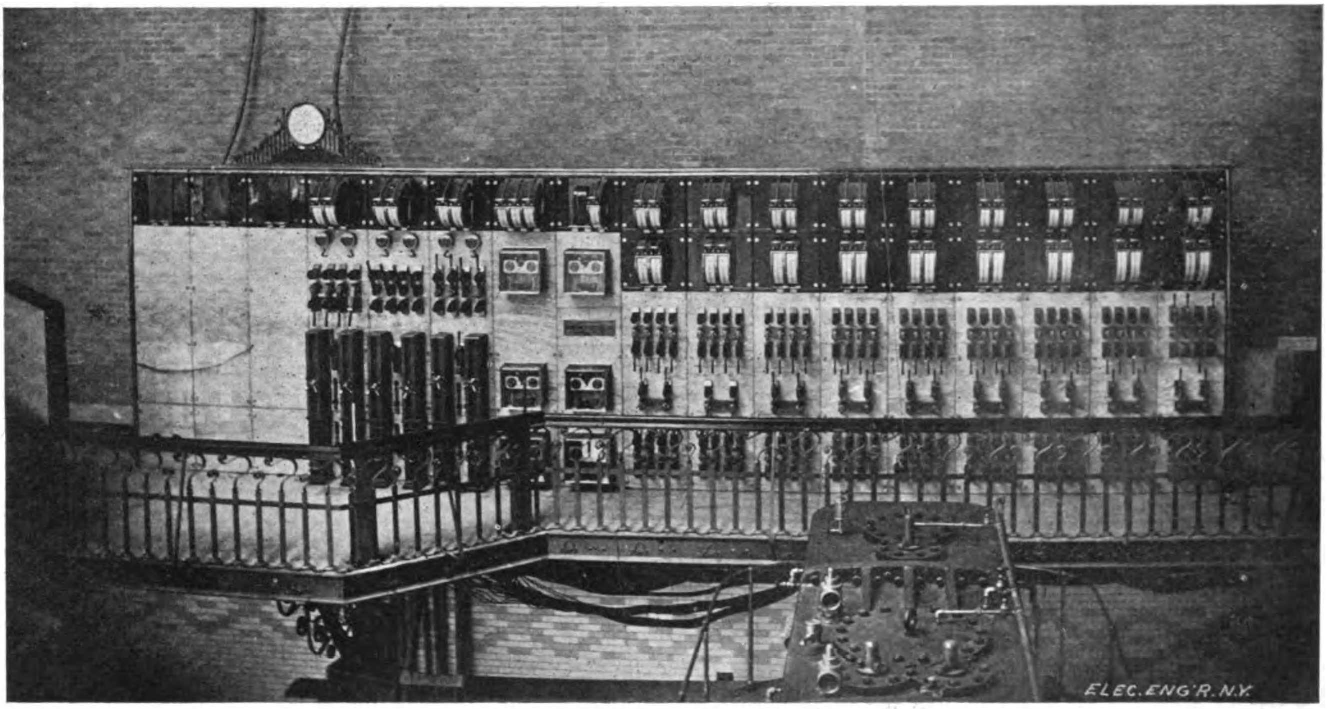
ELECTRIC GENERATORS AND AUXILIARY APPARATUS.

The electrical apparatus was furnished by the General Electric Co., and includes two M. P. 12— 400-120 generators, four M. P. 10— 200-150 generators and motors for driving pumps, fans, stokers, etc.

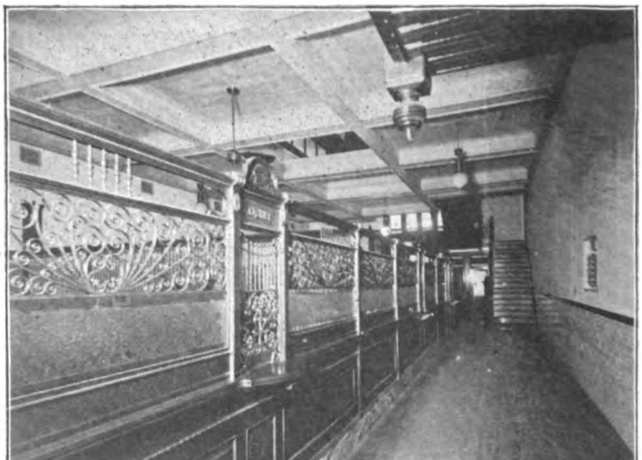
There is also installed a combination set consisting of a standard low frequency 150 k. w. monocyclic generator direct connected to a 250 volt multipolar ironclad motor. The motor will take its current from the station bus-bars, and the alternator will be used to supply alternating current for lighting in the districts which are beyond the reach of the present three-wire system. The considerations of floor space and flexibility render this set exceedingly economical for the conditions existing at New Orleans, and as a further consideration, there is a possibility that at some future time, when alternating current direct driven generators are installed, the set above referred to can be placed in some outlying part of the city and operated backwards; that is, with the alternator as a synchronous motor, to supply current to feed into the outside wires of the three-wire system.

In addition to the motor driven alternating generator a steam driven set of 300 k. w. is being installed, composed of a compound condensing Williams engine of the same type as those already described, and an A. M. 48-300-150 generator. This latter is chifly added to secure reliable service to the customers and used during the heavy load hours when the direct current units are loaded to their capacity.

The switchboard shown below was also built by the General Electric Co., and is made of blue Vermont marble highly polished. There are three bus-bars on it, so that three different pressures can be delivered from the board at one time. All switches are arranged so that when they are thrown up the pressure is increased on the feeders, and when thrown down the pressure is lowered, and the regulators work the same way. The instruments used are of the Van Vleck-Weston edgewise type.



SWITCHBOARD GALLERY, NEW ORLEANS EDISON STATION.



VIEW IN OFFICES, NEW ORLEANS EDISON CO.

The output of the station is registered on Thomson recording wattmeters, of which there are six, two for each bus-bar. The switchboard is elevated 15 feet above the engine room floor, where the attendant has full view of everything that is going on, and at the same time has all the working parts of

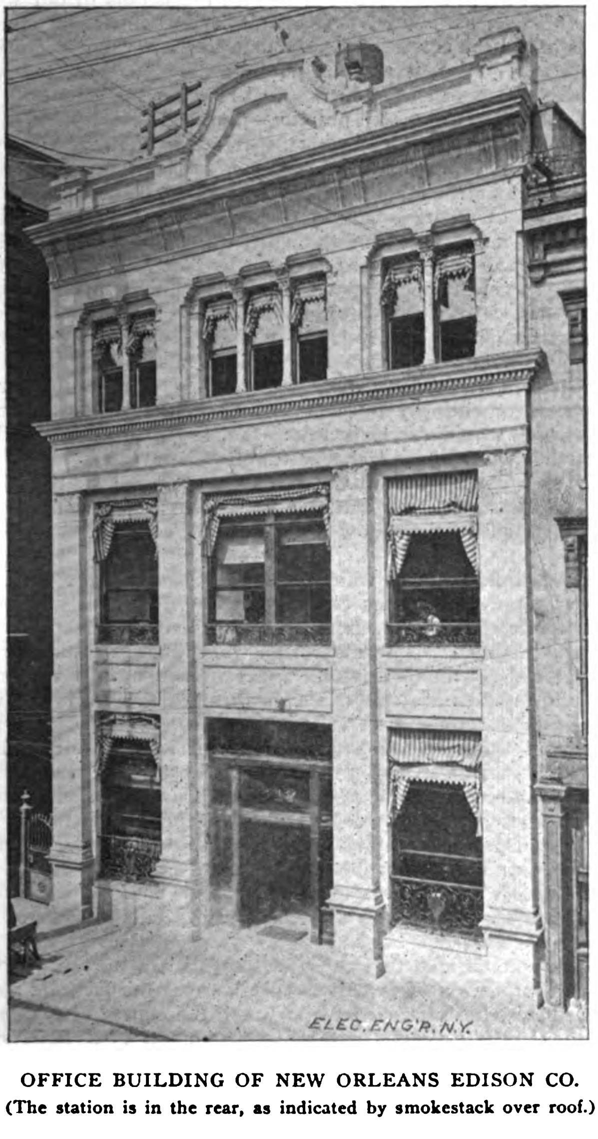
the board easily under his control, as the generator panels and testing instruments are within a radius of four feet.

While the Thomson recording wattmeters just mentioned indicate and record the production, there are means provided at every stage showing the economy in operation or the condition of the apparatus; namely, volt and amperemeters, wattmeters showing the energy consumed by the various auxiliaries, scales, water meters, showing the performance of boilers and engines, etc.

The engraving on page 79 shows the exterior of the office of the New Orleans Edison Company, which faces on another street but abuts on the station, being cut off from the latter by a fire wall, through which are openings conecting the two. The interior view of the office shows the accounting department. The meter department and daughting room are also located in the office building.

THE COMPANY'S OFFICERS.

The present officers of the company are: W. T. Hardie, president; Ed. L. Bemiss, vice-president and general manager; W. J. Kehl, secretary and treasurer. Mr. S. D. Greene, of the



OFFICE BUILDING OF NEW ORLEANS EDISON CO.

(The station is in the rear, as indicated by smokestack over roof.)

General Electric Co., is one of the directors. The building of the new station has been directly under the charge of Mr. J. B. Craven, the general superintendent of the company. Mr. Frederic Sargent acted as consulting engineer. To him and to Mr. John Kruesi and Mr. Craven is due the credit of the general design and layout of the plant. The result has been a most happy one, and the company is to be congratulated on the possession of a plant up-to-date in every respect.

Have read The Electrical Engineer for the last seven years and have always found it excellent.—W. P. M., Brooklyn, N.Y.

German Lighting Plant For Buenos Ayres.

A special cable dispatch from Berlin, of January 4, says: The German Trans-oceanic Electric Company, with headquarters here, has been formed, with a capital of 10,000,000 marks ($2,500,000), for the purpose of erecting electrical stations in America.

A central station will first be established at Buenos Ayres for lighting and general supply.

MECHANICAL

The Comparative Cost of Steam and Electric Power.—VI.

(Concluded.)

BY IRVING TAYLOR.

COMPARISONS.

In Table 7 we have gathered together the final cost results for both steam and electric power, so that they may be available for easy reference, and we have also plotted them out as curves in the accompanying diagram, so that their significance may appeal graphically to the eye.

Referring to the curves, the heavy solid lines show the cost of electric power; the light solid lines the cost of steam power with coal at $4 per ton; and the dotted lines the cost of steam power with coal at $2 per ton. It will be seen that, with the rather ideal case (case I, curves A and a) of a load factor of unity, the electric power has the advantage in cost over steam power, with coal at $4, until 25 h. p. is reached. Above this

TABLE 7—COST OF STEAM AND ELECTRIC POWER.

H. P. of Plant.	Description of Plant.	Load Factors. Ideal, Constant Load. 1.00	Variable Loads. .46	.18
		Cost of Power; Cents per B. H. P. H.		
	Electric motors	3.9	6.9	10.02
10	Engines; coal at $4	4.92	9.19	22.05
	Engines; coal at $2	4.32	8.18	20.
	Electric motors	3.58	4.06	7.98
25	Engines; coal at $4	3.47	6.1	14.28
	Engines; coal at $2	2.99	5.33	12.72
	Electric motors	3.46	3.87	4.96
50	Engines; coal at $4	2.54	4.47	10.22
	Engines; coal at $2	2.14	3.86	9.05
	Electric motors	3.41	3.79	4.87
100	Engines; coal at $4	2.14	3.41	7.56
	Engines; coal at $2	1.79	2.89	6.57

power steam is cheaper than electricity, and becomes increasingly cheaper as the load increases.

Comparing curves B and b (case II), it will be noticed that electric power has the advantage of steam power on the score of cheapness until 50 h. p. and 80 h. p., with coal at $2 and $4, respectively, are reached, after which steam power is a little cheaper. It will be remembered that this case II is what may be called the lower limit of variable load cost.

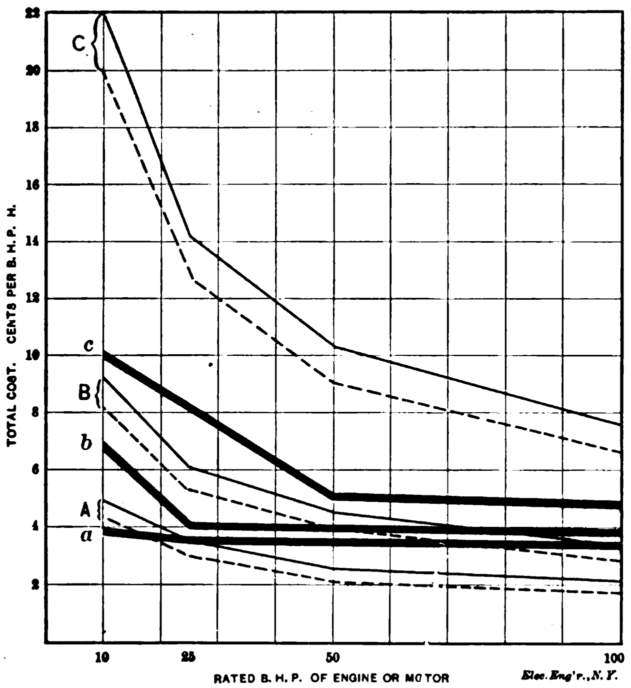
We will now consider the upper limit, which is case III. Comparing curves C and c, it will be seen at once that electricity has an enormous advantage throughout. The spaces between curves B and C for steam power, and between b and c for electric power, may be taken to include the cost of power for all cases of variable loading. A mere glance serves to show that, within the limits of power chosen, electric power, on the cost account alone, easily holds the field.

We are now in a position to view this question of the size of load factors from another standpoint, from which we may be enabled to understand why it is, even in those plants where more or less data has been obtained as to their working, that the load factors are generally thought to be much higher than they really are. This is due to the fact that the indicated h. p. is generally used as a basis of opinion and figures instead of the brake h. p. To illustrate our meaning we will take the case of the 10 h. p. engine, with a load factor of 46 per cent. in case II, and 18 per cent. in case III, and show how

much these figures are increased by calculating on the basis of indicated power instead of actual power.

It must be remembered that, as we have explained before, what we have called the "load factor" is in reality the factor of plant loading. As we wish to call attention to the actual load factor we will distinguish it by the term "actual," and the reader will understand that we designate by that term the ratio of the average indicated load to the maximum indicated load.

In table 3 B and 3 F, multiplying each of the amounts opposite "I. h. p. input" by the corresponding hours per day at that input, summing up and dividing by 10 (hours per day) we



COMPARATIVE COSTS OF STEAM AND ELECTRIC POWER UNDER VARYING CONDITIONS OF LOAD.

Steam Power.—Dotted lines, coal at $2 per ton; solid lines, coal at $4 per ton.
Curves A—Steam power, Case I.
Curve a—Electric power, Case I.
Curves B—Steam power, Case II.
Curve b—Electric power, Case II.
Curves C—Steam power, Case III.
Curve c—Electric power, Case III.
Most cases of variable load steam power will lie between curves B and C.
Most cases of variable load electric power will lie between curves b and c.

obtain the average I. h. p. of 8.9 in case II, and 6.1 in case III. Dividing each of these amounts by 14.3 (which is the maximum I. h. p. of the engine), we obtain a load factor of 62.2 per cent. in case II, and 42.7 per cent. in case III, as against 46 per cent. and 18 per cent. respectively, when the load factor was based on the brake h. p. output. If we divide the above figures, 8.9 and 6.1, by the maximum figures found opposite "I. h. p. input" in tables 3 B and 3 F, that is, by 12.3 and 8.3, respectively, we will obtain figures which are the actual load factors, based on the I. h. p. of 72.4 per cent. for case II and 73.5 per cent. for case III. Both of these actual load factors are what might seem, at a cursory glance, to be very satisfactory, the one in case III being even somewhat higher than that in case II. This is the reason why most men think their plants are operating under favorable conditions, when, as a matter of fact, if the results were reduced (as they ought to be) to actual brake h. p. they would shortly form a very different opinion.

It will be understood that these widely differing results are merely due to the constant internal frictional load of the engine, and apply with still greater force to that larger, external, frictional load—the shafting—which is only used in transmission, and may often be entirely discarded when electric motors are used. Following this line of thought, it may be said in a general way that, owing to the fact that most classes of machinery use power rather intermittently, a rather high load factor will oftentimes only indicate that there is a large constant loss of power in the transmitting devices; so that, on the very field in which electricity is at somewhat of a disadvantage on the cost score as compared with steam, it is often possible, by its use, to entirely overcome that disadvantage by cutting down the wasteful transmitting machinery. In fact electricians generally count on this fact, and it is an every-day occurrence to see a steam engine replaced by several motors with a much smaller total power.

On the other hand, if the load factor is very low, it generally indicates that there is not a large constant load of any kind, and that the chances of reducing the power actually delivered are rather slim. It will be noticed by reference to the curves, however, that, in this field steam power cannot compete with electric under any circumstances.

We must ask the reader to give our statements some breadth, as we have not ourselves done so, but have made them as precise as possible, so that, in proportion as they are valuable, they may make an impression which shall be definite. Nor have we gone deeply into litigious arguments concerning the truth of any statements, for fear that, having stated those conditions by which their truth should appear, they might seem thereby to be conditioned and not to apply to some cases or conditions which we may have omitted; but we have endeavored, as much as possible, to give the details of our work, and to leave, as it were, the scaffolding by which our conclusions have been erected, in order that, in the varying conditions found in practice, it may be possible easily to perceive what influence they will have on the final results.

It is hard to meet practice—practical experience—with "theoretical notions." Anyone will admit that, especially if he has tried it. And so it is a very difficult thing to meet power users with long years of practical experience, with the message that power is costing them something. Most of them think that it is not costing them anything to speak of; yet how is it possible that small, isolated plants can generate power so cheaply when business enterprises which make this their sole work, and deliver comparatively enormous amounts of power, cannot do it? It simply is not possible! One reason why it seems to be so is because the power account is such a small one that a large portion of it, averaged over a number of years, is unwittingly not charged against it. But the main reason, it would seem, is this: Isolated plants and modern central station practice charge for power on two entirely distinct bases; the one, on the rated horse power of the plant, and the other on the actual horse power. A glance at the curves A and C will show the enormous discrepancy between them.

Time alone will tell which is actually the cheapest mode of power supply, all things considered; for, though it may seem impossible to frame a convincing argument to meet this so-called "practice," it seems certain that what the Darwinians would call continuous natural selection will form a very convincing style of argument, and is forming it. Everyone who has been watching electrical development for ten years past has seen this. It has gradually forced its way along lines which have proven to be thoroughly substantial; and once it gets a hold anywhere it never lets go. And this same natural selection is gradually weeding out the antiquated things, and ways, and people, whether they realize it or not; for, as Huxley once said of the problems one meets at every turn in life, "They don't even give a word and a blow, and the blow first; but the blow without the word; and it is left to you to find out why your ears are boxed."

If anyone thinks that these statements are not based on a broad foundation of fact, it is only because the facts lie somewhat below the surface; let him watch the course of events for the next twenty years, for the best arguments of electricity are in its actual triumphs. Truly, the populace is right when it says that "electricity is in its infancy;" it is, as far, at least, as its application is concerned.

A Patent Office Record Broken.

A dispatch from Washington of January 3 says: Last Friday's business was the largest in the history of the patent office, the fees received that day amounting to $9,376. Friday was the last day in which inventors who had patents in foreign countries and desired to take out similar ones in this country could take advantage of the old law which protected these patents for the full legal term in this country. Nearly 48,000 applications for patents were received by the office during the year, 4,000 in excess of the largest previous year.

LETTERS TO THE EDITOR

The Action of Alternating Enclosed Arcs.

IN the Dec. 11, 1897, issue of the "Electrical World," there was published an article entitled, "Tests of an Alternating Current Inclosed Arc Lamp," by Mr. M. H. Baker. While no special criticism of this article is necessary, most of the information therein contained being already well known and understood by those experienced in these matters, attention should be called to one or two statements which are misleading in their character, and which Mr. Baker would probably not have made had he had more experience with arc lamps than he apparently has had.

The first statement is that regarding the use of solid carbons. The article says: . . . "but the use of two solid carbons is practically impossible on account of the tendency to extinguishment." This may be the result of such tests as Mr. Baker may have been able to make, but is not so in fact; on the contrary, it is perfectly possible to use solid carbons in the inclosed alternating arc lamp and with no greater tendency to extinguishment than with cored carbons, and with even better results, provided one knows how to do it.

Again, the statement is made that "the arc does not with the cored carbons tend to climb up the side of the carbon, as frequently occurs with solid carbons," and that "the flaming effect . . . is invariably the sign of too great a current consumption for the size of the carbon."

These statements are not borne out by experience. The flaming effect mentioned takes place equally as well and as frequently with cored carbons as with solid carbons and has nothing to do with the current consumption ratio to the size of the carbons and can easily be remedied and prevented in any alternating inclosed arc lamp; provided one knows how to do it.

Again, among the alleged reasons for this abnormally large current consumption, is the one of "a lower frequency than that for which the lamp was designed, the last reducing the choking effect of the inductive resistance, thereby allowing more current to pass."

Experience in this direction does not corroborate this statement. On the contrary, it is perfectly possible to design an inductive resistance or choke coil which shall enable an arc lamp to run equally well on all frequencies of alternating current from 7,000 to 16,000 alternations, without any change of coil or lamp, provided one knows how to do it.

The inclosed alternating arc lamp is a comparatively new thing and is a study in itself, and much time and thought has been given to it by many able minds, and much valuable information exists on the subject, but which it known only to the discoverers thereof and which is at present kept as stock in trade and not given broadcast to the public, for obvious reasons.

It is to be feared that Mr. Baker has met with certain anomalies and difficulties in handling lamps of this description, and in lieu of absolute facts to account for them, is guessing.

G. B. FRALEY.

Philadelphia, Pa.

Defects in Electrical Specialties.

The article of Mr. H. N. Gardner in The Electrical Engineer of November 25 on "Defects in Electric Specialty Designing," calling attention to faults and flimsy construction is well timed, only some of these defects ought to have been cured years ago. The faults that Mr. Gardner speaks of are so glaring that if a wireman has to go four blocks from his shop he had better take along extra material; that is, if working on a six light job he had better take along seven sockets, cutouts, etc., so as to be on the safe side. A man is likely to find screws missing, more likely screws that are so loose that they will not hold. Then another great fault is the small wood screw holes in some switches and other specialties.

Let me call attention to most cutouts and other electric appliances that show that the people who design them don't have to use them. That is, the screws and washers that hold the fuses and wires are so close up to the rim or shoulder that it is difficult to pass a wire or fuse around the screw.

But the worst of all is in one well known type of transformer which has a porcelain block in the top with all the terminals on it. When you want to run your wires into this transformer you will find the terminals for the primary in a straight line with the hole and bushing. But the secondary terminals are offset to one side and you have to bend a short square turn in your large secondary wire and sometimes break the rubber bushing in the case.

Then, again, canopies on combination fixtures should be made deep and long so that they would cover neatly the insulating joint and cutout and, say, two inches at the nipple on the gas pipe.

Probably this doesn't come under the same head, but could not some manufacturer make a common, cheap testing magneto that was not so large and did not weigh 8 or 9 pounds like those used at present?

HENRY FARLEY.

Galveston, Tex.

OBITUARY

Burr K. Field.

IT is with feelings of deep regret that we announce the death of Mr. Burr Kellogg Field, vice-president of the Berlin Iron Bridge Company, who died at his home, Berlin, Conn., on Thursday morning, January 13, after an illness of less than a week. His death was so sudden and his sickness so short, that few of his friends were aware that he was ill. Burr K. Field was born in May, 1856. He entered the Sheffield Scientific School of Yale University in 1874, and graduated in 1877 as a civil engineer. Immediately after graduation he commenced practical work among the railroads of the West. His principal experience was in connection with the laying out and building of the Northern Pacific. Mr. Field had charge of the locating and building of the branch connecting the Yellowstone National Park with the Northern Pacific. In 1882 he was appointed Superintendent of Bridges in the city of Philadelphia, which position he held for something over a year, when he resigned to accept a position as Assistant Engineer of the Berlin Iron Bridge Company. His advancement in that company was very rapid, and at the time of his death he occupied the position of vice-president with general charge of all the sales. Since his connection with the Berlin Iron Bridge Company its business has been much extended and its sales have increased wonderfully year after year. Mr. Field had no small part in the making of the enviable reputation which the Berlin Iron Bridge Company now enjoys, and his death will be a severe loss to his associates. He was an indefatigable worker, not only for the company which he had so faithfully served, but in everything he undertook; a true friend of his fellow-men, a devoted and earnest worker in the church, a staunch friend to the cause of temperance; active and energetic in every public position that engaged his attention. Mr. Field had a most pleasing manner, and he enjoyed an enviable reputation for his business methods and rectitude among the manufacturing corporations of the country. People who knew Burr K. Field best trusted him most. He is survived by a wife and two small children.

BOSTON BELL BUOYS.—Steamship people are greatly interested in the efforts to have the government permanently establish electric bell buoys on State ledge and Nix's Mate Since the steamship companies discontinued maintaining these guides to navigation, illustrated and described in The Electrical Engineer, complaints have been frequent, and it is the earnest desire of steamship captains and the shipping community in general that the government take early action in this important matter.

"I like The Electrical Engineer better than ever, and would not be without it."—A. W. McWilliams.

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Warning.

WE wish to warn our readers against an unsigned circular issued by one of our contemporaries accompanied by a fac simile of a letter from the advertising agent of one of the electrical manufacturing companies. Further publicity to the letter has been stopped on investigation, by the president of the company, and its publication forbidden. The circular that accompanies it aims to injure the whole electrical press, except the journal issuing it. Such efforts have failed before, and this, the latest, is equally deserving of scorn and contempt from all honorable men. If necessary we shall go into the details of this matter. For the present, we deem it sufficient to expose one more trick, where others have been exposed before.

Mr. Dana Greene on the Consulting Engineer.

IN the early days of electric lighting, when power and other electrical applications of the current were discussed as mere possibilities, the customer who desired to install a plant dealt directly with the manufacturing electric company. There were no consulting engineers, for the simple reason that all those who had sufficient technical electrical knowledge to have acted as such, found good and remunerative employment with the manufacturing companies. The latter, on the other hand, finding themselves unrestricted in the matter of design, were enabled to carry out their own ideas as dictated by experience. and hence developed rapidly a standard series of machines which could be duplicated indefinitely at reduced cost, and which have enabled them to comply very well with most of the conditions met with in practice. We believe that those conversant with the progress of the art will admit that much of the enormous expansion in electrical current application in the United States is due to the fact that the companies were thus left unhampered and that open competition among themselves served to develop higher and higher standards of efficiency accompanied by a reduction in cost to the user. But as time passed, the consulting electrical engineer entered the field, and it cannot be denied that a point has been reached at which it seems desirable that, for the benefit of all concerned, a better understanding should be arrived at between the customer, consulting engineer and the electrical manufacturer. That the consulting engineer fulfills a useful and important function, no one will deny, just as the architect is the proper intermediary between the owner and the builder. But where conditions may be laid down in specifications involving a departure from the established manufacturing standards, it seems worth while to inquire whether some mutual understanding cannot be reached to put the manufacturer to the least trouble and expense, which, of course, must in the end be borne by the customer. This whole question is very ably and impartially treated in the paper read last week by Mr. S. Dana Greene before the New York Electrical Society. Mr. Greene makes the point, first, that the electrical engineer is too apt to hold aloof from the manufacturer, on the assumption that his motives for approaching him closer may be misconstrued, or that by consulting him he might endanger his own standing as to technical competency. The result, as Mr. Greene points out, is that requirements are often called for which put the customer to additional expense, but for which there are no compensating advantages. One of the remedies suggested by Mr. Greene is that consulting engineers should avail themselves of all possible opportunities to visit manufacturing establishments and confer with the engineers of the manufacturer. This is excellent advice, and as no self-respecting electrical manufacturer has anything to hide or pretends to the employment of mysterious processes in its methods of manufacture, the following out of such a practice by consulting engineers can lead only to beneficial results for both. In fact, one could hardly wish for a better opportunity to learn than to have placed at one's disposal the experience of our manufacturing companies, gained at the expense of hundreds of thousands of dollars in experimental work. Mr. Greene does not go so far as to say that every condition can be met by a piece of standard apparatus, but insists that much of the special apparatus called for in engineers' specifications is unnecessary, and to that extent leads to a needless expenditure of money.

In the discussion which followed the reading of Mr. Greene's paper it was only too manifest that manufacturers treated engineers' specifications with an amount of consideration inversely proportional to their length. Of course, some of the consulting engineers present took the ground that the conditions of each individual case varied so much as to make a standard rather difficult to carry out in practice; to which Prof. Crocker made the epigrammatic reply that if such were the case the remedy would be in changing the conditions. To meet the existing state of affairs Mr. Greene suggests that a national body, such as the American Institute of Electrical Engineers, take up the matter with a view to formulating a code which shall embody such rules and regulations as will constitute a standard for current generating and motor apparatus to be followed by all alike, whether as manufacturers or as engineers. In our opinion this plan is a most excellent one and ought to be carried out at an early date. Indeed, we understand that the Institute has just such a plan under consideration at this present time, and we hope Mr. Greene's paper will expedite the work. The valuable assistance given by the Institute to the standardization of rules for the wiring and installation of electrical apparatus is fresh in the minds of all, and has been a great boon to the whole industry. It can make its influence in, and value to, the electrical fraternity still greater if it will now lay down some plan which will enable the manufacturers of generating apparatus to meet one another on common ground. We imagine that the consulting engineer would be the last one in the world to object to such a code, as it would at once relieve him of certain responsibilities and place upon him the burden merely of ascertaining whether the recognized standards had been lived up to in the apparatus furnished.

The Coming Electrical Exhibition.

MATTERS in regard to the Electrical Exhibition, to be held next May at Madison Square Garden, New York City, are now quickly shaping, and some forecast of the affair may be made with approximate accuracy. The last show, so brilliant a success, is only two years away, and one might reasonably have supposed that exhibitors were hardly ready or anxious for another. The contrary is the exact truth. The management is beginning to be somewhat perplexed as to the due allotting of all the space already contracted or applied for, and the letters they have received from numbers of intending exhibitors prove that a very lively interest exists everywhere on the subject. Two years ago, when business was bad and dull, the show was a splendid stimulus to trade and general inquiry for electrical apparatus. Is it not fair to infer that now, when all the wheels of industrial machinery have been set going again, and when everybody's purse is fuller, the opportunity to push business and make sales is an even better one than it was then? We believe that the coming show will be a better chance to display and sell apparatus than anything that has ever presented itself in this part of the country, and it is

evident that scores of shrewd exhibitors think so, too. The wealth and brains and energy and respectability of the electrical field are back of this show, and they may be relied on to see it through to an even more successful finish than that undertaken with so many doubts and fears during the panicky days of 1896. The management of the Exhibition is comprised of well known men who enjoy the respect of the community, and their efforts are being ably seconded in every influential direction.

It will be very interesting to see the trend of electrical affairs as manifested now, compared with only two years ago. Perhaps there is no art or industry to compare with electricity for steady, permanent gains combined with an incessant change of front and outlook. We are certainly far away from the situation of 1896 in many respects; yet it has virtually all been gain, and there is an entirely new aspect of affairs in many highly important branches. Of such matters, this Exhibition may be expected, even more than the last one, to give the public an authoritative and well rounded idea. It will be no fault of the management if it does not; for, while they take willingly their chances of financial success or failure, we know them to be more animated with the ambition of promoting the common cause in the eyes of the public, which, after all, is the buyer, user, or patron of everything that bears the name of electricity.

At the last Exhibition, springing as it did out of the displays made at each convention, there was given to the work of the National Electric Light Association a noteworthy impetus, which is gratefully remembered by the supporters of that body. This time, in view of the extraordinary interest then shown locally, the management have joined hands, on invitation, with the New York Electrical Society, the oldest electrical body in the country, to help it in its excellent educational work; and we shall be very much surprised if this common endeavor to impress the many-millioned public of Greater New York does not bring, as desired, large accessions to the membership of this useful, hard-working and creditable local society. Dr. Pupin, the president and his associate officers, have, we know, large ambitions for the prosperity and growth of the organization; and they will certainly spare no effort to enlarge, through this golden opportunity, its sphere of influence and service, while adding largely to the active membership. The Society has always gone along modestly but steadily, and it will now be advertised in a way that will enable it to derive direct benefit from its long career, stretching clear across two decades. It sprang out of the technical yearnings of a handful of telegraphers, many of whom have achieved eminence; while to-day, when it is 400 strong, the most prominent electricians in New York, like the youngest, feel honored to belong to it, or to be among its officers. Indeed, the American Institute of Electrical Engineers owed its origin to the feeling among members of the Society that there ought to be a national body on similar lines, and there has always been a large proportion of local Institute members in its ranks. All this augurs well not only for the success of the coming Exhibition, but for the growth of the New York Electrical Society as a local institution, and we urge upon all its loyal members to make the most of the present occasion, for it may be a long time before they get such another.

Telephone Lines as Common Carriers.

IT would appear that under the laws of Massachusetts, any telephone company is obliged to give any person or corporation, a telephone or telephone service, on payment of regular charges. We confess our deep doubt until recently that such a principle could be, or was being, enforced; and we imagine that the news will startle a good many people who have been discussing the "common carrier" aspect of the relations between "old line Bell" and the new "independent" telephone companies. The question came up at the famous Detroit independent telephone convention last year, and it seemed to be taken for granted that exchange of business would have to be fought for, and was in every case a hard won concession rather than a right. For ourselves, we have been unable to see why a Bell manager should not take all the business offered him, so long as it was paid for, being just so much additional income, no matter what its source; and that it was good financial policy to invite custom rather than repel it. Noting that the People's Telephone Company, at Haverhill, Mass., was delivering business to the local Bell Company, we have inquired into it, and Mr. N. N. Spofford, the local manager of this independent company, presents us with his data and views in regard to this situation. It appears that about two months ago he went to Mr. Keller, the well known general manager of the New England Company, and asked for a telephone on the pay station basis, and while Mr. Keller at first thought he could not do so, he had the good sense to make a contract with the People's Company on the regular basis, so much per year, for telephone office; and this is now on the pay station basis. In this way the main objection to the "independent" service—of its strict physical limitations—is done away, while it is obvious that the New England Company is also thus deriving revenue from its rival. There are, we believe, a few independent exchanges elsewhere turning in business to Bell companies, but it is not our information that they are on a pay station basis; though some of them may be. Mr. Spofford takes pride in having an instrument of his company in the office of the Western Union Telegraph Company. The People's Company has nearly 200 instruments in use, with a growing patronage, and is reaching out into other towns and cities; though with pay station privileges over all the Bell lines, it would hardly seem necessary to go in for much "extra territorial" extension. As we said last week, in regard to New York, there is an entirely new telephone situation developing, as this further instance shows, quite disregarded by the daily newspapers that jump in or jump on the telephone art once in a while; and we venture to suggest to them and others that it is worth keeping an eye on the new adjustments that are coming rapidly with the new telephonic times.

Municipal Ownership in Atlanta.

THE campaign for and against municipal ownership at Atlanta, Ga., has been lively, and has been attended by a number of interesting developments. It will be remembered that Atlanta has one of the best private plants, and one of the best services in the whole South, justifying the challenge which we printed recently from Mr. Atkinson, president of the Georgia Electric Co., to name any municipal plant that could show as good a record as their private one. At a recent public meeting in the city, Mayor Collier, when speaking on the subject was reminded by one of his audience of Mr. Carroll D. Wright's remark that there were no reliable statistics on the subject; and that the mayor's figures in favor of municipal plants were all wrong. That did not "phase" the mayor at all. His Honor immediately replied: "I happen to know something about Mr. Wright which would taint with suspicion anything he might say on this question. The statement of his former business partner is enough to condemn Mr. Wright, and, personally, I believe the charges are true." Cheerful, to say the least, and deliciously vague as most slanders are, Mr. Wright's only crime has been his endeavor to set on foot an investigation by the Government, as to this whole municipal plant business; and the moment some of our municipal friends—not all of them—are invited to stand up and be sifted they break out in abuse of the disinterested and matter-of-fact investigator; while the private electric lighting companies are doing all they can to aid the Government in its work. A fair inference would be that the contention of the companies that they give as good service as the municipal plants, at a genuinely cheaper rate, is well founded; and that the fantastic figures of municipal economy on the other hand will not stand daylight. However, we shall see, when Mr. Wright gets through. Meantime, Mr. Collier is swallowing his words, and retracting his abominable insult to one of the best officers in the Government employ—for the country is served by good men as well as bad. We are glad to append, and give publicity in full, to Mr. Collier's groveling retraction, as printed in the Atlanta Journal: "In my remarks at the Chamber of Commerce dinner a few evenings since I made a statement upon information, reflecting upon Mr. Carroll D. Wright, commissioner of the Department of Labor. Upon investigation I find that the information upon which this statement was made was erroneous in ascribing the alleged breach of faith to Mr. Wright. I make this correction, without solicitation, in simple justice to Mr. Wright, who, I learn, is an honorable, conscientious and painstaking official." We will simply add our own comment, to the effect that Mayor Collier's data in favor of municipal ownership has all been as well founded as his assault on Mr. Wright.

ELECTRIC TRANSPORTATION

The New Heilmann Electric Locomotive.

BY L. BAYLY.

(Electrical Engineer, Paris.)

THE first of Mr. Heilmann's electro-steam locomotives described, was tried and approved of at the close of 1893 on the Chemin de Fer de l'Ouest. The experiment took place between Havre and Beuzeville, the locomotive pulling trains of 206 tons up the gentle incline separating these two towns, at a speed of 25 miles per hour. Perhaps it will be as well to mention that the maximum speed as yet attained has been 68 miles per hour. Concerning the economy and practical advantages of Mr. Heilmann's system there still remains a good deal to be said, and indeed at first sight it would seem almost impossible for any practical utility to be got out of a machine working in apparent defiance of all the laws of the conservation of energy. Here, however, another train of reasoning comes into play, and the specific disadvantages of ordinary railway engines have to be taken into account before attempting to pronounce judgment on the Heilmann locomotive.

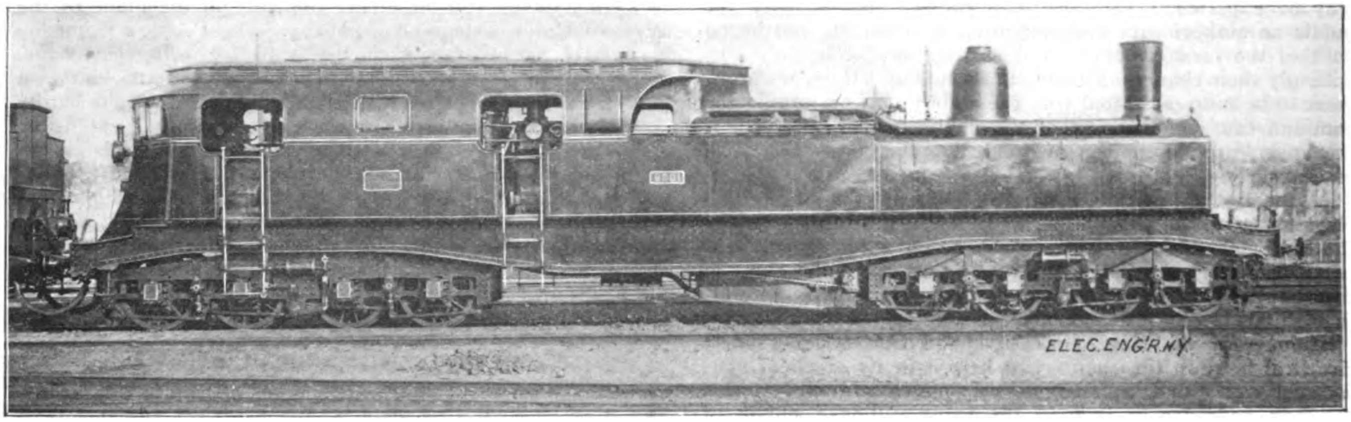
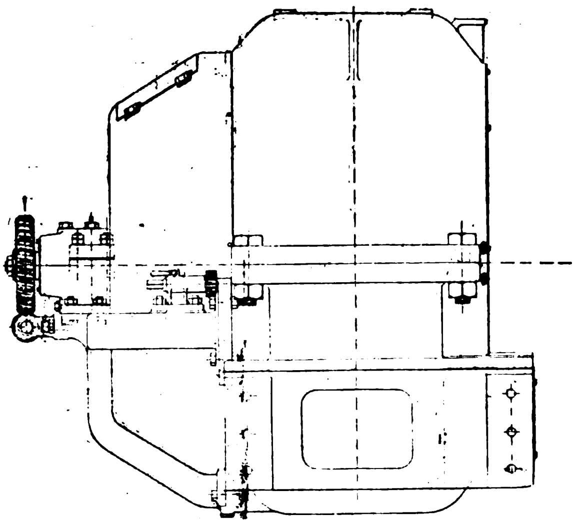


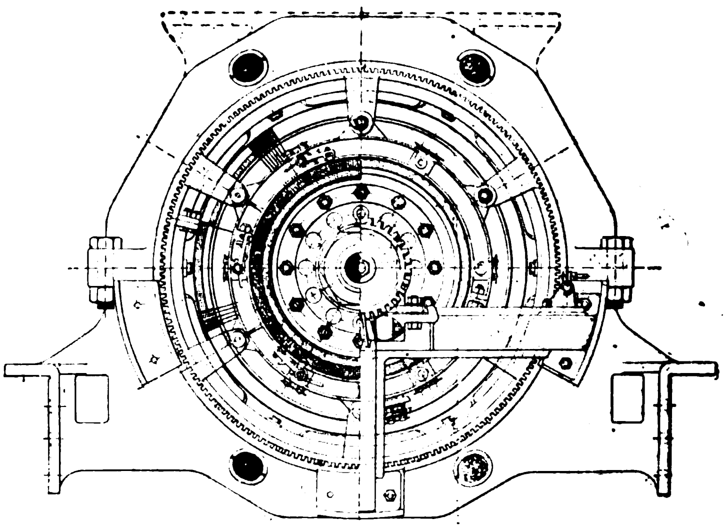
FIG. 1.—THE NEW HEILMANN ELECTRIC LOCOMOTIVE, WESTERN RAILWAY, FRANCE, CONTAINING A COMPLETE EQUIPMENT OF STEAM ENGINES, BOILERS AND GENERATORS.

In fact, the popular idea about a miraculous speed being the aim and object of Mr. Heilmann's strivings is both erroneous and unfounded. Mr. Heilmann's desire has been to create a more perfect traction engine than any hitherto in use. A locomotive is, owing to its very nature, an uneconomical and variable contrivance. The principal aim of engineers has been to make it work economically between the largest possible limits. This aim is realized by the Heilmann locomotive.

The following is a detailed description of the latest type: Each engine, as will be seen in Fig. 1, is shaped something in the form of a 16-wheel bogie carriage. A tubular boiler of 185 square meters heating surface supplies motive power for two six-poled dynamos contained in the prow of the engine and capable of delivering a current of 1,000 amperes under an electromotive force of 450 volts. The engine in use is a six-cylinder one of 1,350 h. p.; the moving parts work in oil and the whole is concealed under a covering of steel, secure from dust and needing no especial attention.

The energy developed by the dynamos is communicated to 8 electric motors mounted directly on the axles of the wheels. These latter measure 45¾ inches in diameter and work independently of each other. As will be noticed from the illustration, one of the principal features of Mr. Heilmann's system is the evenness with which the weight of the whole structure is distributed over the axles, the maximum strain on each being about 3,300 pounds, instead of, as in the case of many other splendid engines, nearly three tons. The Heilmann locomotive, being built on the bogy principle, is also more flexible, and the enormously increased "grip" resulting from the large number of driving wheels, renders skidding impossible. The evenness of gait observed in the recent trial trips is partly due to the constancy of the motive power exerted on the axles, the imparted energy being uniform and invariable throughout the whole revolution.





FIGS. 3 AND 4.—GENERATOR OF NEW HEILMANN ELECTRIC LOCOMOTIVE, SIDE AND END VIEW.

As to the question of coal consumption, I might state that since the first experimental run between Havre and Beuzeville the consumption of fuel has diminished from 24.3 pounds to 13 pounds per mile. The Lentz type of boiler has, in the new form of Heilmann engine, been replaced by one of the

ordinary locomotive type. The following are some of the data of this boiler:

Grate area, 3.34 square metres; heating surface (furnace), 16.47 square metres; heating surface (tubes), 169 square metres. Total, 185.47 square metres.

Number of tubes, 351; exterior diameter of tubes, .045 metres;

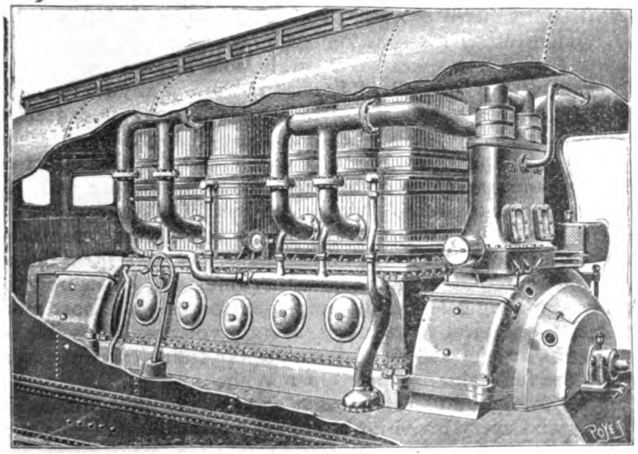


FIG. 2.—VERTICAL ENGINES ON NEW HEILMANN ELECTRIC LOCOMOTIVE.

length of tubes, 3.80 metres. The boiler is of iron and the draught is the ordinary locomotive exhaust draught.

The engines, which are shown in Fig. 2, are of the vertical pattern. This form was adopted partly with the intention of saving space, and of obviating the difficulties that might result from induced vibration in the bogy frame.

In employing a horizontal engine, more especially one working with its axis at right angles to the line of travel, complications need rarely set in, but in the case of a vertical engine they become almost unavoidable, the maximum inertia efforts taking place in a direction parallel to the oscillations of the engine frame on its springs. Should the strokes of the piston rods coincide even approximately with the swinging movements of the frame, the vertical vibrations may reach dangerous limits.

With a view to obviating this, the six-cylinder idea was

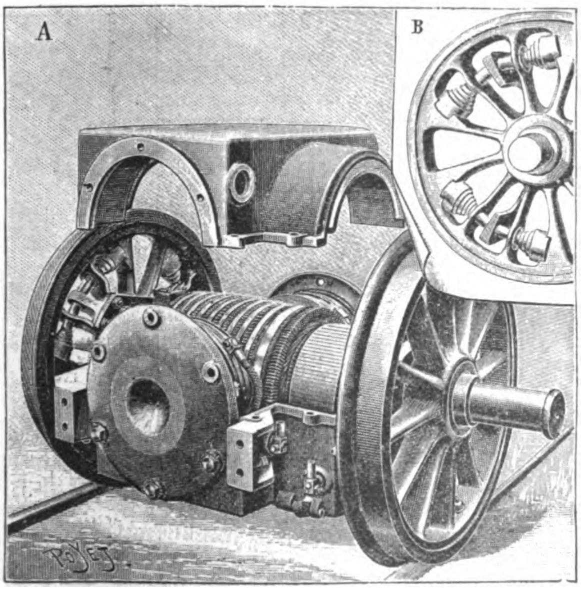


FIG. 5.—VIEW OF MOTOR AND SPRING CONNECTION WITH WHEEL.

proposed at one and the same time by Mr. Robinson and M. Mazen. The cylinders are each of them 13 inches in diameter and the maximum number of revolutions is 400. A governor of the centrifugal type is attached and the speed can be regulated between the limits of 100 and 450 revolutions per minute. The two dynamos are coupled direct, one at each end of the axle. They are from the workshops of Brown, Boveri & Co., and are coupled in parallel. They are 6-poled, the armature being a drum with the coils wound in parallel, air-spaces being left between the iron discs to insure ventilation. The current is collected by six sets of carbon brushes. The engravings, Figs. 3 and 4, show the construction of the dynamos. An auxiliary dynamo has also been added, serving both as exciter and for the purpose of feeding the train lamps. It is driven by a 28 h. p. Willans engine, and gives a current of 140 amperes under an electromotive force of 115 volts.

The motors are four-poled, wound in two coils. The magnets are of steel and are bolted direct to the bogy-frame. The upper magnet is removable, as shown in Fig. 5, thus permitting the inspection and repairing of the armature. The latter is multipolar series drum wound and the current, as in the case of the dynamos, is collected by carbon brushes.

The normal capacity of each motor when the locomotive is running at 75 miles an hour is 125 h. p., which corresponds according to calculation with an approximate pull of 748 pounds at the axle of each wheel. The maximum total effort exerted on each wheel axle during the trial trip amounted to 2,640 pounds. Fig. 6 shows the motor in sectional view. The motion of the armatures of the motors is transmitted to the wheels through the medium of a set of springs, as shown in Fig. 5 B. By this arrangement all shocks at starting are avoided. A controller allows the eight motors to be worked either in groups of four or all in series and a second switch gives a reverse movement by the reversal of the current in the armatures. Each motor has its own amperemeter, cut-out and fusible plug.

There are two cabs from which the engine can be worked,

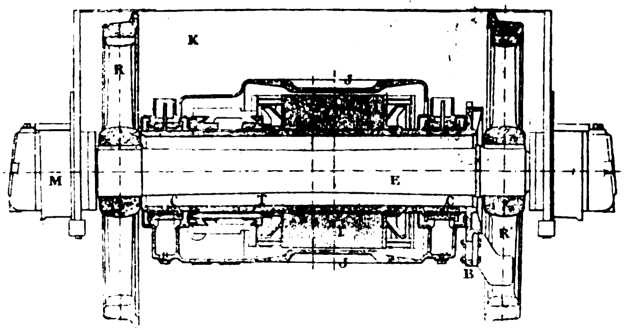


FIG. 6.—MOTOR MOUNTED ON AXLE, HEILMANN ELECTRIC LOCOMOTIVE.

one in the front of the steel prow, the second, as in ordinary railway engines, behind the boiler. The whole can, therefore, be worked both ways, but the first named method, viz., from the prow, is obviously the most convenient. The engraving, Fig. 6, shows the coupling of motor and shaft.

Following are the general dimensions of the locomotive: Length between buffers (total), 52 feet; distance between bogies, 39 feet; width of cab at prow, 8 feet 6 inches; extreme height (rails to funnel), 13 feet 5 inches. The efficiency of the whole may be figured as follows: The power delivered into the engine cylinders is estimated at 1,305 h. p. The efficiency of the engine is 90 per cent.; that of the dynamos 95 per cent.; that of the motors 90 per cent. This gives, taking all losses into account, including 2 per cent. in the conductors, a total of 1,154 h. p., or nearly 850 kilowatts at the dynamo brushes. These figures vary very little between the extremes of speed at which an express train is compelled to run.

If we now try to estimate the dynamic output of the engine, taking into account the amount of power absorbed by the machine itself, i. e., the difference between the power delivered at the wheel axles and that delivered at the draw bar, we find that this difference varies slightly with the speed, and with the weight of water, etc., carried.

The following are M. Drouin's figures: Supposing the locomotive to weigh 115 tons and to carry 17 tons of water. At a speed of 63 miles the pull exerted at the wheel axles will amount to 5,940 pounds. The energy necessary for overcoming the weight of the engine will be $(115+17)\times 7 = 2,032$ pounds. This gives a power of 3,907 pounds at the draw bar. Expressed in horse power, the available power at the draw-bar is 657 horse power and the output of the engine stands thus: $657 \div 1,350 = 47.1$ per cent.

The efficiency of any and every locomotive is at all times subject to considerable variation. The problem has been to construct an engine that will remain economical between the widest possible limits. This ideal has been realized by the Heilmann engine.

The Caffrey Trolley Road Wagon.

BY W. G. CAFFREY, RENO, NEV.

IN the consideration of the subject of motor vehicles of the trolley type as an economical method of freight transportation, several important points arise at once. Can a vehicle be produced to compete successfully with existing methods of transportation? This is the most important point and if settled satisfactorily it will surely point out the line of development to be followed. The resistance to traction of the average railroad, including the various curves, can safely be placed at 15 pounds per ton; the fuel consumption at 7 pounds of coal per h. p. hour; the average running speed of freight trains 20 miles per hour; the schedule averaging about 10 miles per hour, and the actual working time of engine and crew brings it to about 6 miles per hour. The cost of construction varies with the country traversed, the traffic to be handled and the weight and capacity of its rolling stock. A safe average assumption of cost of roadbed and equipment of a modern road would be about $50,000 per mile.

FIG. 1.—SIDE VIEW CAFFREY WAGON, SHOWING TROLLEY ATTACHMENT.

With this data as a basis to work upon, a careful calculation as to the probable cost per ton mile for freight transportation gives us at once the maximum amount which a motor vehicle could command; but if this cannot be reduced, it is more than probable that capital would not touch it. A careful analysis of the situation shows that the first cost or capitalization is a prime factor. Interest will keep running up when everything else has sense enough not to move.

The main cost of a railroad being its roadbed, eliminate this element from the motor vehicle line as much as posible. Grades in railroads occupy a large proportion of an engineer's thought not so much as to the cost of climbing them, but how steep a grade they can stand. In a motor vehicle system the thought is how much will it cost? To eliminate the roadbed feature of a railroad in a motor vehicle system suggests the existing highways, used in a manner not to interfere with their present use.

This brings us to the strength of the bridges and culverts along these highways and the present maximum loads hauled thereon; the character of the roads and the speed with which motor vehicles can safely and economically traverse them. These settled, and the tractive resistance to be encountered and the power required by this system can be closely approximated.

In the comparison of a motor vehicle with a railroad the tractive resistance immediately becomes an important feature. Spring suspension, roller bearings and wheels of comparatively large diameter and wide tires all tend to reduce it. Not being able to reduce it to an equality with railroad practice, we must then endeavor to meet the difference by producing power more economically than railroad practice shows. The result of this comparative analysis suggests a system as follows:

A system using the existing highways as much as possible, having the trolley wires on a single pole line on one side of the road, with wagons flexible enough to run anywhere along the road, of general appearances similar in a great degree to those now in use—using wheels of somewhat greater diameter and of considerable width of tire to increase tractive effort or adhesion and prevent mud and soft roads interfering with the traffic to a great extent; a moderate speed of about 6 miles per hour and vehicles not to weigh over 7 tons; tires smooth on the exterior, so as not to cut up the roads, but pack them down; utilizing water power wherever obtainable, and, when not, the best engineering talent to be employed to design a most modern and economical steam plant, using a voltage, if possible, of 1,000 volts instead of 500. Scheduling the trains carefully so as to get the full value of the copper in the system.

Such a system, utilizing the best engineering skill obtainable, and any and every invention designed to increase the efficiency of the system can transport freight in open competition and parallel any railroad in existence, and prosper on rates one-half less than any railroad can. For high speed express and passenger traffic the railroad will be the one par excellence. For moderate speed and cheap transportation of freight and passengers the motor trolley vehicle will be the result. Canals will again assume their former activity as freight highways for the motor trolley vehicle will take the place of the tired mule.

To carry out a system of transportation as herein contemplated, the writer has laid down the following requisites which he considers necessary for a successful solution of such an undertaking. The freight motor wagon will correspond to the following specifications:

Rear driving wheels, 8 feet in diameter, with smooth steel tire 26 inches wide; roller bearings to fit the spindle and geared to the motor. The rear axle to have a vertical movement, subject to the opposition of elliptical springs. There will be motors for each rear wheel and spring suspended from the main frame. Each motor at its intermediate gear is to have a band brake, which can be operated both at once or separately; also a clutch which can be used to throw both motors together when required.

FIG. 2.—REAR VIEW, CAFFREY ELECTRIC TRACTION WAGON.

Motors are to be of the regulation street railway type, but

rated differently and controlled by the regular series parallel controller; all the apparatus to be suspended below the body of the wagon. In front will be the controller lever, the band brake, levers, the clutch lever, the lever controlling the trolley cord and the air brake valve and steering lever or wheel.

The front axle will be pivoted at its center to a forging spring suspended from the frame and have a vertical movement at its outer ends of 12 inches. The wheel spindles to be pivoted as closely as possible to the hub, with arms extending forward for steering or turning. The front wheels are to have 4 feet diameter and 16-inch tires.

The trolley consists of two metallic frames connected together by an insulated lazy tongs arrangement. Each frame carries two trolley wheels running on top of trolley wire and kept there by two locking wheels beneath, which, when passing a pole recede in a horizontal plane sufficiently to pass the wire support. The wire supports are of malleable iron and attached to the side and insulated from the pole; on the side of the trolley facing the road four steel guides are attached to lazy tongs, to which the cord or cable conveying the current to wagon is attached. These guides keep the cord central and brace the trolley. The trolley cord or cable is of sufficient length to permit the wagon to run 200 feet away from the pole line and is reeled or unreeled from wagon.

An experimental wagon built to test the practicability of the scheme outlined above has been built and is illustrated in the accompanying engravings. Figs. 1 and 2 show the wagon in side and front views. This wagon operated very successfully. It ran within 2 feet of the pole line and 200 feet away, in and out among teams and in no case did it hit or scare any of the numerous teams. The wagon is equipped with a 2 h. p. crane motor of the Westinghouse pattern, controlled by a commutator controller. The power generator was a 5 h. p. Westinghouse dynamo. With this outfit on a level hard road we acquired a speed of 15 miles per hour with a load of 2,500 pounds on the wheels. Fig. 3 gives the details of a 30-ton wagon.

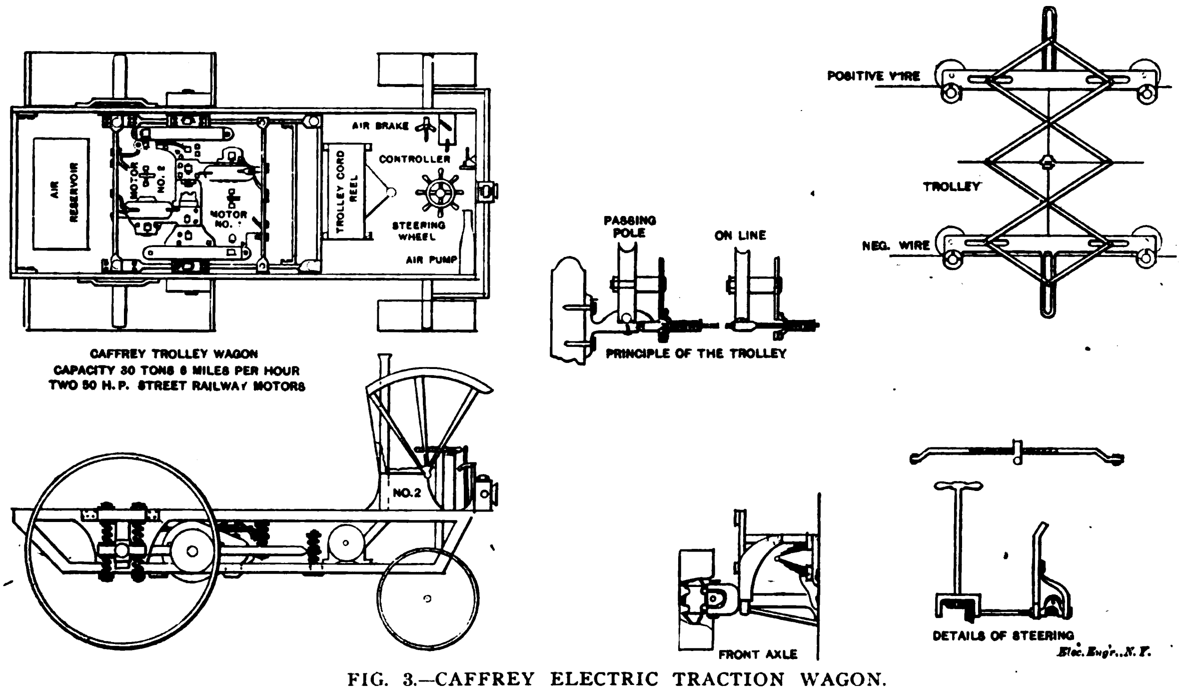


FIG. 3.—CAFFREY ELECTRIC TRACTION WAGON.
(Details of Construction of Motor, Trolley, Steering Gear, Etc.)

A Projected 34 Mile Road From Rochester.

There is a movement on to build an electric road between Rochester, N. Y., and Mt. Morris by way of Avon and Geneseo, a distance of about 34 miles. Capitalists of the above named places are considering the matter, especially at Geneseo and Mt. Morris, where the accommodations by rail are very poor. The Rochester Street Railway Co. published a notice in the daily papers a short time ago to the effect that they would do all possible to carry out the project. C. F. Whiting, superintendent of the Avon Electric Light and Power Co., of Avon, N. Y., is promoter of the scheme.

Data as to the Electrical Operation of the Proposed New York Underground.

We are indebted to the courtesy of Mr. W. B. Potter, engineer of the railway department of the General Electric Company, in response to our application, for the subjoined data furnished to Mr. W. B. Parsons, chief engineer of the New York Rapid Transit Railroad Commissioners, as to the cost of electrical apparatus and equipment for the proposed underground road:

We take pleasure in submitting herewith the data from which we prepared our estimate recently given you on cost of electrical apparatus and equipment for the New York Rapid Transit Railway. The train service specified between Post Office and 97th street consists of three-car local trains on one minute headway at schedule of 13 miles, including stops, with stations 1,500 feet apart; and also five-car express trains on two minute headway at schedule speed of 35 miles per hour, including stops, with stations 7,500 feet apart; the road to be four track between Post Office and 97th street.

North of 97th street the road to divide into east and west branches, both local and express trains from below 97th street running alternately on one branch and the other above junction point. The train service is similar for both branches and considering either branch by itself, there would be two of the three-car locals for each five-car express from below 97th street, this giving a headway between trains of one and one-third minutes for each of the branch lines.

The service on these lines for the three-car trains would be equivalent to a one-minute headway and for the five-car trains to a two-minute headway, both three and five-car trains running at schedule of 18 miles per hour, including stops, with stations 3,000 feet apart.

Based on the train service as above given, following is an estimate of power required for the different character of trains:

Route. Post Office to 97th street.

Distance, 7 miles.

	Character of train. Local.	Express.
Schedule speed, including stops, miles......	13	35
Number of stops..........................	25	5
Distance between stations, feet............	1,500	7,500
Headway between trains, seconds..........	60	120
Duration of stops, seconds................	10	15
Number of cars per train..................	3	5
Weight of train, loaded, tons..............	60	140
Maximum speed, per hour, miles...........	24	63
Assumed tractive effort per ton, pounds....	120	140
Corresponding watt hours per ton mile.....	127	159

	Character of train. Local.	Express.
Total tractive effort, pounds	8,000	19,600
Traction coefficient of motor car, per cent	10	12
H. P. per train at axle	38½	552
H. P. per train at power station	177	1,105
Total number of trains	65	12
Total H. P. at power station	11,500	13,300
Number of motors per train	4	8

Route above 97th street, East and West branches, both being similar, are considered together.

Distance, 7 miles.	Character of train. Local.	Local.
Schedule speed, including stops	18	18
Number of stops	12	12
Distance between stops, feet	3,000	3,000
Headway between trains, seconds	120	240
Duration of stops, seconds	10	10
Number of cars per train	3	5
Weight of train, tons	80	140
Maximum speed, miles	31½	31½
Assumed tractive effort per ton, pounds	85	85
Corresponding watt hours per ton mile	119	119
Total tractive effort, pounds	6,800	11,900
Traction coefficient of motor car, per cent	8½	7½
H. P. per train at axle	115	200
H. P. per train at power station	230	400
Total number of trains per branch	23½	11½
Total for both branches	47	23
Total H. P. at power station	10,800	9,200
Number of motors per train	4	8

Summary of service, Post Office to 97th street:

	Local.	Express.
Schedule speed, including stops, miles	13	35
Number of trains	65	12
Number of motor cars	65	24
Number of trail cars	130	36
Total H. P.	11,500	13,300

Above 97th street, including East and West branches:

	Local.	Express.
Schedule speed, including stops	18	18
Number of trains	47	23
Number of motor cars	47	46
Number of trail cars	94	69
Total H. P.	10,800	9,200

Grand total of system:

H. P. at power station	44,800
Number of motor cars	182
Number of trail cars	329

In preparing estimate on cost of investment, we have allowed for certain reserve, both in power station and in number of cars, as you will note. The investment is based on a single power station located on the east branch where it crosses the Harlem River. Have estimated on three-phase generating apparatus with rotary converter substations located at different points of the line, as required. The cost of power station equipment for stations of this size would not be materially affected whether one or two stations were built, nor would it be affected by the number of substations within probable limits.

The estimate as prepared contemplates eight or ten substations feeding directly into a third rail of 100 pounds cross section or larger, thus dispensing entirely with low potential feeder copper. The items of lighting equipment for the tunnel and stations, and also tools, are a matter of conjecture and subject to modification.

Estimate on cost of the electrical equipment and rolling stock, complete, ready for operation, based on previous assumptions, is as follows:

Power station, 50,000 h. p., at $63	$3,150,000.00
200 motor cars, at $10,800	2,160,000.00
350 trailers, at $3,000	1,050,000.00
Rotary converters and transformers, 50,000 h. p., at $16	800,000.00
High potential feeder line	360,000.00
Feeder ducts, insulators, etc	54,000.00
Third rail, 56 miles, at $3,500	196,000.00
Lighting equipment of tunnel and stations	25,000.00
Tools	50,000.00
	$7,845,000.00

The cost of power station, as given, does not include real estate, the items being made up as follows:

	Per H. P.
Building and foundations	$12.00
Engines and condensers, erected	18.00
Boilers, erected	15.00
Generators and switchboards, erected	11.00
Piping	4.00
Stack	2.00
Feed pumps, etc	1.00
Total per h. p.	$63.00

Bonding of track I have assumed at $700.00 per mile, which is rather in excess of usual cost, but the work in this case needs to be very substantially done.

Conduit ducts for feeder wire will cost from 12 to 18 cents per foot, depending upon number of ducts and labor incidental to laying them.

The motors for each motor car equipment have a nominal rating of 175 h. p. each. This rating, in accordance with standard practice, is based on a given temperature rise for an hour's run at rated load. Under operating conditions the motors will perform an average of from 20 to 30 per cent. of this rated horse power within safe temperature limits.

As regards cost of power, many modern power stations are producing it at the switchboard for four mills per horse power. Several records that we have give as low as 3.8 mills. This cost per horse power hour includes everything incidental to the generation of power, and comparing the operation account of a number of power stations in the vicinity of New York, with coal at $2.20 per net ton, I find that the average cost for the different items per horse power hour is about as follows, in percentages:

	Per cent.
Fuel	48.
Operation (labor)	35.
Operation (supplies, oil, waste, etc)	9.
Maintenance (labor)	5.
Maintenance (supplies)	2.5
Maintenance (building)	.5
	100.

There are numerous details regarding feeder distribution, train control, sectioning of third rail, etc., that I have not touched upon and, being details that are necessarily affected by plans as finally decided, presume you do not care for a discussion of them at present.

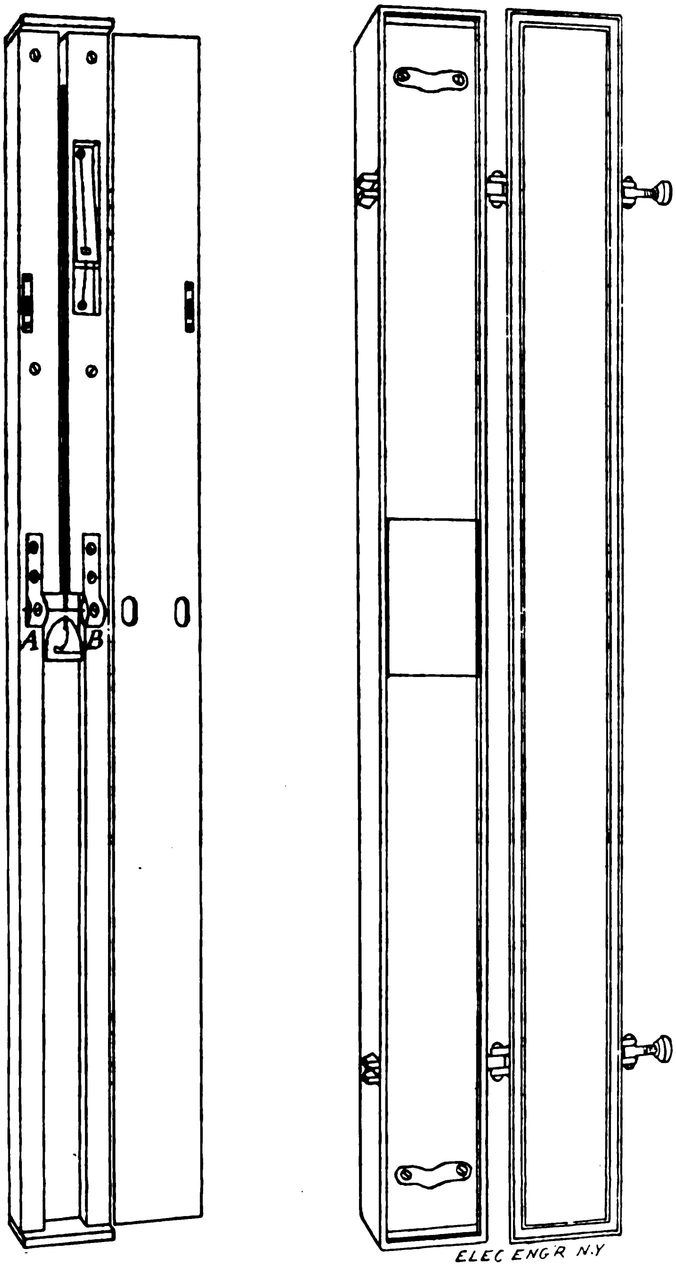
The Cravath Excessive Current Recorder.

It is generally admitted that a city electric road requires from 15 to 25 per cent. more energy to operate it than would be required were all the motormen to handle their controllers carefully and intelligently with a view to using as little as possible without getting behind time. No small part of this waste is due to a too rapid turning on of the power in starting, thereby spinning the wheels, throwing away the efficiency of the series combination on the series parallel controller and overloading armatures by cutting in field shunts too soon. This practice is also detrimental when carried too far, because with the sizes and types of motors commonly employed it results in overheating the motors, besides causing excessive fluctuations in the voltage and requiring the constant running of a large capacity of generating machinery.

The Cravath excessive current recorder is designed to afford an electric railway management a knowledge of the excessive use of current by various motormen without interfering with the operation of the road. It is a simple apparatus designed to go on each car and keep a continuous record of the efficiency of each motorman along the line indicated, and is the only instrument of the kind on the market. The presence of such a recording instrument has the practical effect of making all the motormen careful and efficient. This has been practically demonstrated on one road equipped with them where the saving in actual coal consumption amounted to 15 to 20 per cent. after the recorders had been on long enough to educate the motormen in economy.

The instrument consists of two parts. The recorder proper, Fig. 1, is given to every motorman before he starts out on his

run, is put in position on the car by him, and at the end of the run turned in by him at the office. This recorder fits into a recorder case, Fig. 2, which is a fixture on the car, and contains the car circuit terminals. The act of pushing the recorder into its case closes the car circuit through the recorder, and unless the recorder is in its place the car circuit is open and the motorman cannot run his car. The recording device con-



FIGS. 1 AND 2.—CRAVATH EXCESSIVE CURRENT RECORDER.

sists of two very simple elements, a horizontal German silver wire held between the terminals A B, and of such cross section as to be heated by the current operating the car, which flows through it, and a thin strip of alloy of low melting point. This strip of alloy is supported in vertical guides above the wire and held against the wire by a weight champed to its lower end, as shown in the illustration. When the temperature of the wire has reached a certain point due to the passage of current through it, the wire begins to melt its way through the alloy strip and the strip and weight descend. The amount of strip melted through in a day, divided by the car mileage, is used as a record of the motorman's efficiency.

In practice the hot wire is made of such a size that a good man under ordinary conditions will melt through but little of a strip, the strips being 17 inches long, while some of the more careless men will go through the full length. The proper size of wire is determined by actual experiment with a careful motorman in regular service, and of course will need to be varied with the weight of the car and local conditions. The instrument records according to the square of the excessive current flowing.

As to practical operation this recorder is ideally simple. When the motorman is called for his run he is given a locked recorder containing a fresh strip of alloy. As is seen by the illustrations it is a strong wood box. It contains simply a weight, an alloy strip, a hot wire and two terminals, which terminals are provided with switch lugs on the back which fit into switch jaws in the iron recorder case on the car, to complete the circuit when the recorder is pushed into position. It contains also an automatic short circuiting device as a precaution to prevent injury to the instrument or stoppage of the car should the hot wire melt under an abnormal current. This, however, seldom occurs.

It is but the work of a few seconds for the motorman to shove the recorder into the case, close the case door and be off. At the end of his run he turns it in at the office and the clerk unlocks and reads it at his leisure. If more than a small fraction of the strip is melted through a new one is put in and the old one thrown into the scrap pile to be sent back for remelting and rerolling. The cost of these strips is thus made nominal. The refilled recorder is then put in the pile ready to go out. A record of "miles run" and "inches melted" is kept for each man, and the clerical work is so slight that it can in most cases be done in spare moments by men already employed.

While a man may have bad luck as to delays and heavy loads one day, such things will not happen to the same man all the time, so that the comparative record is perfectly fair. This device is manufactured by the Cravath Manufacturing Co., 825 Monadnock Building, Chicago., of which company Mr. J. R. Cravath, the inventor of the device, is president.

Public Control, Ownership or Operation of Municipal Franchises?—III.

With Special References to Electric Lighting.*

By R. R. BOWKER,

(Vice-President and General Manager New York Edison Co.)

MUNICIPAL INDUSTRIES IN THE GREAT CITIES.

THE pages following give the facts and figures as to municipal industries in the great cities of the world, chiefly as to lighting, but with reference also to other industries, when the experience is significant or distinctive:

PARIS.

Paris has its gas supply exclusively from a private company, the Compagnie Parisienne, resulting from a consolidation a generation ago, covering the city and suburbs under an exclusive concession given in 1855, and extended under the contract of February 7, 1870, through 1905. This had in 1896, in addition to 93,044 burners for public lighting, 347,295 customers; the year's consumption was 318,020,060 cubic meters and the receipts from sale of gas 80,876,336 francs. Under the contract with the municipality, its price to private consumers is 30 centimes per cubic meter ($1.64 per thousand cubic feet) and to the city half that rate. In 1896 it paid to the city 5,470,187 francs in royalties of 2 centimes per cubic meter sold, 200,000 francs for sub-soil privileges, 8,800,000 francs as half of its surplus profits, in addition to 1,235,002 francs for expenses in the maintenance and care of street lamps—in all 15,705,189 francs;

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the business cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

and to the State in various taxes, 1,095,720 francs; together, 16,800,910 francs, or the equivalent of 5.3 centimes per cubic meter, or 20 per cent, of its total receipts from sale of gas. Thus, out of $1.64 charged per thousand cubic feet, 28.6 cents is returned to the city of Paris in a tax actually paid by the gas consumer, without which the price would be $1.35 per thousand cubic feet. The Compagnie Parisienne has issued 336,000 shares of 250 francs, of which it has amortized 188,513, leaving 147,487 shares (or $7,374,350) present share capital; it has issued 553,332 obligations of 500 francs, of which it has amortized 237,136, leaving 316,916 bonds (or $31,619,600) outstanding. It has paid 5 per cent. on its bonds and in 1896 the enormous dividend of 26 per cent. on its stock, an extraordinary showing of what can be done by a private company occupying an exclusive field in a great city.

Paris has six electric lighting companies, each occupying a "secteur" of the city under a municipal concession for 18 years expiring in 1907-8, and a small municipal plant in the central market house. These seven systems supply 744 street and 7,056 commercial arc lamps and 416,000 incandescent lamps (chiefly 10 and 16 candle power) and there are 4,000 arcs and 286,900 incandescent lamps on private plants, making a total electric installation for all Paris of 11,800 arc and 702,900 incandescent lamps. There are but 500 electric motors in all Paris, power being supplied largely by compressed air. The municipal contract limits the price to 15 centimes per hektowatt hour (30 cents per unit) for lighting and 6 centimes per hektowatt hours (12 cents per unit) for power purposes. The average price is about 11 centimes per hektowatt hour without lamps, somewhat above the American maximum price of 1 cent per 16 candle power lamp, which includes lamps. The six private companies have a share capital of 48,000,000 francs and obligations of 15,500,000 francs, and one company has a floating debt exceeding 30,000,000 francs. Three of the companies pay 5, and one 4 per cent. dividend; one has never paid dividends, and one is just beginning.

The electric light companies have recently petitioned the municipality to extend these concessions for a further period of 25 years, and M. Charles Bos, a member of the Municipal Council, has presented (1897) a most careful and valuable technical report on this question. He states that the present price of electric current is practically equal to the price of gas burned in the ordinary way. The distributing system in Paris is chiefly under the sidewalks and the city retains the right to take over this "canalization" at a fair valuation. The city charge for replacing pavement is stated at 8 francs per square meter ($1.30 per square yard) for stone on concrete and 16 francs ($2.60 per square yard) for asphalt, and for sidewalks 5 to 6 francs per square meter. M. Bos states the cost of coal in Paris at 32 francs per ton, in Berlin at 21.5 francs and in London at 24 francs.

Paris also includes in its sub-soil system ducts for compressed air for power purposes, and a pneumatic service for postal purposes. The telephone system in Paris is in the hands of the government and is much behind the age; until recently calls were made by the name and address of the subscriber.

Oustide of Paris there are recorded in the French cities and towns 28 municipal and 378 company plants, now very important.

BERLIN AND OTHER GERMAN CITIES.[1]

Berlin has a municipal gas plant supplying the city except in the central district, which is supplied by a gas company organized in 1825 by English capitalists, whose charter proved to be an exclusive and perpetual privilege for the heart of the city. The municipal plant produced in 1895-96, 86,213,953 cubic meters, and the private company 31,528,804, together 117,742,757 cubic meters. The municipal price is 16 pfennigs per cubic meter ($1.08 per 1,000 cubic feet) for lighting and 10 pf. (67c.) for heating, and the price from the private company is 15.2 pf. ($1.02) for lighting and 9.5 pf. (64c.) for heating, the private company having kept its price 5 per cent. below that of the municipal supply.

Berlin has but one electric lighting company, the Berliner Elektricitäts Werke, which had in 1896-97 4,067 customers, 196,076 incandescent lamps, 196 street and 8,977 commercial, a total of 9,173 arc lamps, and 7,475 horse power in motors, etc. It delivered in the year, 14,200,000 units and had gross receipts from current of 5,134,300 marks, nearly $1,280,000. It paid to the city under its contract 513,430 marks, being 10 per cent. on the returns for current, etc., and 273,948 marks, being 25 per cent. of its surplus profit above 6 per cent. dividend, together 787,378 marks ($186,000) exclusive of taxes. It also paid into a reserve fund required by law 112,083 marks, into two employés' benefit funds 93,750 marks, and a dividend of 12½ per cent. on the share capital. The base price is 3 pf. (¾c.) per 16 c. p. lamp hour without lamps, being 15 cents per unit, and for power 16 pf. (4c.) per unit. Lamps are supplied at an additional charge of 5 marks ($1.20) per 16 candle power lamp per year. On incandescent light discounts are allowed of from 5 to 25 per cent. according to the number of hours' use of the lamps, and in addition from 5 to 20 per cent. according to the total amount of current consumed. The average return of the Berlin Company for all services, including a supply of current for three lines of electric railways, is about 9 cents per unit. In addition to the company's service there are 348 private plants with 3,690 arc and 85,000 incandescent lamps. Berlin also has a "blow post" sub-soil service in connection with its post-office and a governmental telephone service, which, like that of Paris, is much behind the times.

Outside of Berlin there are in German cities and towns 207 company and 41 municipal plants, the leading examples of the latter being in Frankfort, Dresden, Hanover, Dusseldorf, Cologne, Nuremberg, Bremen, and now in Munich. Vienna has had a gas company, organized by English capitalists, but the Socialist power known to us under the mask of anti-Semitic agitation has carried the point of erecting an operating plant, without taking over or making allowance to the gas company for its existing works, a striking example of municipal confiscation. Electric lighting is supplied by five or more private companies, one of these having one of the largest stations in the world on the banks of the Danube. Buda Pest is supplied by two electric lighting companies, one distributing high tension and one low tension current, and is especially noteworthy for its handling of the transportation question, having a trolley line operated by a private company through underground ducts, the first important installation of its kind, and a rapid transit tunnel electric railway operated by the same company.

LONDON.[1]

London does not own its water front, except along the embankments made during the past generation, and its magnificent system of docks is the work of several different corporations, one of which has a capital of £5,000,000.

London receives its water supply from eight private companies, the oldest, dating from 1608, and one other taking water from the river Lea, a third from chalk pits in the hills of Kent, the other five from the upper Thames, filtering the water through large settling pools. Water rates based on rental value must be paid by the tenant in advance; the house owner must lay the pipes communicating with the mains, except for houses renting under $50 per year, for which the company must on request furnish service pipes, charging for them an additional annual charge, in which case the owner is responsible for the water rates. The London County Council desires to take over the water supply, but bills have so far failed because of disagreement as to compensation. The Board of Works, and now the County Council, has safeguarded the interest of the public; no addition to share capital has been allowed since 1878, and the interest on debentures has since 1894 been limited to a rate that in the judgment of the Governor of the Bank of England would secure issue at par. The companies cannot pay more than 10 per cent. dividend except to make up lower previous dividends; the actual rate has ranged from 5 to 12½ per cent., and the price of the stock ranges from 150 to 420, reducing the actual return to from 2⅞ to 3½ per cent. on present investment value. Any surplus must be invested as a reserve fund in the hands of the City Chamberlain.

London is supplied with gas from three private companies, under close government regulation. The price is from 2s. 5d. to 3s. 6d. (58 to 84 cents) per thousand cubic feet of gas giving 15 candle power in a five-foot burner. Meters are tested by

[1]Die Berliner Elektrizitäts Werke bis Ende 1896, von G. Kemman (Springer, 1897); Die öffentliche Beleuchtung von Berlin, von Dr. H. Lux (Fischer, 1896); Berichte Berliner Elektrizitäts Werke; Elek. Zeitg., 1 Juli, 1897; Tech. Führer von Budapest, von A. E. Illes (Patria, 1896).

[1]Whitaker's Almanac, 1897; Dickens' Dictionary of London, 1897; The Electrician, Supplement, 29 Jan., 1897; Lightning, 25 Mar., 1897; Electricity up to Date, by J. B. Verity (Warne, 1896).

County Council officials at a charge of from 6 pence (12 cents) to 3 shillings (72 cents) or more, for which the gas company pays if the meter is inaccurate and the consumer if it is accurate.

London has ten electric lighting companies and four vestry municipal plants, occupying under "Provisional Order" charters, specified districts of London, in some cases exclusive, in other cases with two companies in competition. The price is limited by the Board of Trade to a maximum of 8 pence (16 cents) per unit. In practice the base rate of the companies varies from 8 pence (16 cents) to 6 pence (12 cents), not including lamps, with a sliding scale reducing the price as low as 4 pence for motive power, or in one case 3 pence if used during the daytime alone. The share and loan capital together of the ten companies exceeds £4,500,000. The sales in 1896 exceeded 18,000,000 kilowatt hours, and the returns £450,000, making an average rate of practically 6 pence (12 cents) per unit, or 6-10c. per 16 candle power lamp hour, which does not include lamps. The most successful, though not the largest of the London companies, received in 1896 an average price of 5.63 pence (11 cents), and its operating expenses were 3.34 pence (6¾ cents). Of the municipal plants only that in the parish of St. Pancras is comparable; its investment is about £109,000; its output in 1896 was 850,000 units; its average price 5.34 pence, and its average cost 4 pence. The other three plants in the parishes of Hampstead, Islington and Shoreditch, are small or new. The last, however, has been designed by enterprising private contractors, who have installed a "destructor" plant, utilizing the refuse from the streets for fuel, and a thermal storage apparatus of the Druitt-Halpin method. This plant was put in operation only in 1897, and no figures are yet available. It promises, however, to present one of the most favorable examples of municipal supply in the world. In the small Hampstead municipal plant the average price was 5.54 pence, and the expenditure of 7.38 pence, so that the ratepayers paid a third of the actual cost. The Crystal Palace private company also showed a loss.

The new County Council thoroughfares in London are supplied with several miles of subway tunnels, accessible from various points and providing access through manholes to the sewers as well as facilities for all kinds of subway service, including water mains, gas pipes, electric conduits and a hydraulic service for elevators and motor purposes at over 1,000 pounds pressure. From these subways alcove connections are made on either side between each pair of buildings.

MISCELLANEOUS

The Relations Between the Customer, Consulting Engineer, and the Electrical Manufacturer.[1]

BY S. DANA GREENE.

THE subject which I have chosen for this paper is an eminently practical one, and I shall endeavor in my remarks to call attention to certain causes of friction which at present exist between the parties in interest, and to suggest certain remedies which may serve to bring about a better understanding and to lessen this friction, which is, in my opinion, entirely unnecessary.

In order to discuss intelligently present conditions, it is advisable to trace briefly the development of the electrical business, and to do this one need hardly go back more than a dozen years. At that time electric lighting was still an experiment (from the commercial standpoint), electric railroading had not begun and electric power transmission was discussed as one of the possibilities of the future. Very few of our institutions of learning had established separate electrical courses, and such a thing as a consulting electrical engineer hardly existed in this country. The few men who had some theoretical knowledge were eagerly caught up by the manufacturing companies, who had difficulty to find men capable of solving the many pressing practical problems with which they were confronted, when they began to sell electric machinery. Thus the development of a practical generator and incandescent lamp immediately created a demand for suitable conductors and materials for outside and inside wiring, safety devices, etc., as well as close regulating engines, proper station appliances and many other things which are to-day regarded as "standards" in the business. It was less than a dozen years ago that the first fireproof switchboard was installed, in the Broadway Theatre. The specifications were drawn by a consulting engineer—a naval officer by the way—calling for a fireproof structure, and the manufacturer no doubt accepted the order thinking that he could use what had always been used before, viz., a wooden framework. In this he was mistaken, however, and after a year's wrangling a slate board was installed, much to the manufacturer's disgust, and at great expense to him. It is hardly necessary to say that this form of switchboard became standard immediately, and several years after, the manufacturer, happening to meet the naval officer, said to him, "Someone was a d——d fool about that switchboard and you were not the man." I well remember when I left the navy to join the Sprague Company in June, 1887, I found that the technical force of the company consisted of Mr. Sprague, an ex-naval officer, and Lieut. Crosby, who had just left the army. Upon explaining to the former how modest was my store of knowledge on the subject of "electric street railways," he at once reassured me by saying that we were all in about the same boat, and that there was a fine opportunity to learn! My opportunity came sooner than I expected when, about July 1, I was charged with the execution of a contract for the equipment of a 40-car road in Richmond, Va., which, under the terms of the contract, was to be in full and complete operation on the first of the following October.

Doubtless most of those present to-night can recall the remarkable growth of electric lighting and railway work, during the next five years, from 1887 to 1892, a growth that can fairly be called tropical. Plants sprang up in nearly every city and town in the country, and manufacturers sprang up with equal rapidity. There seemed to be unlimited money ready to invest in electrical enterprises, and the anticipated profits were such as to make the old established manufacturing industries seem very poor investments. During this period, which may be called the "forced expansion period," purchasers usually had to take what they could get and consulting engineers were few and far between. Specifications for apparatus or installations, when there were any, were generally prepared by the manufacturer, and the purchaser rarely knew whether they had been fulfilled or not. By the close of this period, however, the colleges and technical schools began to turn out men who had taken special courses in electricity and who naturally looked for a chance to make an honest living. The first great demand of the manufacturing companies for technical assistants having been satisfied, many of these young men found their way into local operating companies, or else established themselves as consulting or contracting engineers, in which positions they found plenty of work; for by this time the imperfections in the earlier installations and types of apparatus had become plainly evident, to the purchaser, as well as to the manufacturer, and there was a general demand for better workmanship and more rigid requirements in installation. It may be here noted that much of the "anticipated profit" of the business, both of the operating and manufacturing companies, was spent subsequently in making good these early defects; and while the business as a whole profited largely by this reconstruction process, it naturally dampened the enthusiasm of the early investors.

In 1893 came the panic, and for the past four years there has been a wonderful record of savings and economies, both in electrical manufacturing and operating companies, as well as a great improvement in quality of product. It has been, in fact, the "economic and reconstruction period." The operating companies have learned that they, too, are manufacturers of a product, electricity; and as these hard times have forced down the price of their product, they, like the manufacturers of apparatus, have to keep their heads above water and their companies out of receivers' hands by the introduction of more economical and improved methods of manufacture and of administration. During the past year there has been a marked improvement in the electrical business; it is to be hoped that this improvement is permanent, and that the past four years of retrenchment and economy have paved the way for a normal and steady growth on conservative lines. In other words, for a period of "natural expansion." The business to-day is on

[1]A paper read before the New York Electrical Society, at the College of the City of New York, Jan. 12, 1898.

much the same basis as in other industries, where prices are close, competition keen, and where a better article is furnished for less money than ever before.

The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it, selects first that system best suited to his particular local conditions, and then, in purchasing, secures the best (not necessarily the most) for his money. It is equally the duty of the consulting engineer to learn what the manufacturer can reasonably be called upon to make, to consult with him freely and to obtain the benefit of his experience; to give him credit for work well done, and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant, or to ask him for information or advice. Their idea seems to be that, by so doing, they may be accused of partiality or undue bias, or with lack of proper care for the interests of the purchaser; or they may feel that it is derogatory to their own dignity as independent engineers. The inevitable result is that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages, from either the engineering or commercial standpoint. In fact, some of these provisions are impossible or impracticable of fulfillment; and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required, finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them.. This is a proceeding which is always difficult and delicate to undertake, and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur, to visit manufacturing establishments, see the work there in progress and confer with the engineers, he would find himself well repaid for the visit, and his own work and practice benefitted thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary would welcome such visits as beneficial to both parties. The day of mysterious methods of manufacture, carried on behind closed doors, is passed in the electrical business, and I appeal with confidence for an endorsement of the opinions just expressed, to those consulting engineers who have already tried the plan suggested. I have said that I thought the engineer would find himself repaid by such visits. I think, also, that he will find himself in a better position to advise his client intelligently. A purchaser usually knows little or nothing of the relative technical merits of apparatus, and his final decision is governed largely by price and by paper statements and guarantees, which may mean much or little. The consulting engineer who has seen the apparatus in process of manufacture can advise not only as to whether the various bids comply with the specifications, but also what make or makes of apparatus are, from their design, construction and factory inspection and test, most likely to give the least trouble and expense in continuous service.

Some engineers seem to measure their value to the purchaser by the length of their specifications, and some of these formidable documents strike terror to the heart of a busy man confronted by a desk full of mail. The specifications not only specify what the conditions of service are, what apparatus is required and what tests shall be applied to it for acceptance, all of which are quite proper; but also how it shall be built, which is another matter. The electrical manufacturers of this country following the admirable precedent which has given American manufactured products (particularly machinery) a world wide reputation, have endeavored to establish standard lines of apparatus, whenever the permanency of type and the size of the demand warrant it. This practice not only tends to reduce cost (and with it price), but also enables the purchaser to secure quickly and at a minimum of expense, duplicate parts which are really duplicates and which can be fitted without the aid of a skilled mechanic. It is the American system of standard lines of machinery and interchangeability of parts, which has stood the test of time and which holds its own against all competitors. This system, however, is possible only where the same article is manufactured in quantity, since the expense of designs, drawings and patterns, special tools, jigs, dies, etc., is prohibitive unless spread over a large production. On the other hand, if special apparatus is required, it means a relatively large expense for these items which cannot be charged to a standard product, and which thus constitute a handicap both to the manufacturer and the purchaser. A machine is "standardized" only after long experience, both in manufacture and service, and other manufacturers (the builders of engines, trucks, etc.) as well as the users, are invariably consulted before such standardization. It would appear to be to the interest of both seller and buyer to use such standard machines wherever and whenever possible; and yet it seems to be a fact that the demand for special machines is increasing, rather than decreasing, as apparatus becomes more generally standardized. To prove this I can cite the experience for the past year of one manufacturing company, with which I am familiar. During this period, the designing engineers were called upon for estimates on special apparatus, as follows:

Direct current:
Number of estimates 300
Number of kw. of app. involved.................. 31,000
Alternating current:
Number of estimates 300
Number of kw. of app. involved..................131,200

These estimates were all embodied in formal propositions; besides these were between two and three times as many preliminary estimates required to answer inquiries of customers, which the engineers had to prepare.

This was in addition to their regular work on standard lines of apparatus, of which there are over thirty. Some of this work was undoubtedly due to new developments in the business and to new methods and inventions, a condition which, although unfortunate from the manufacturing standpoint, must exist for many years to come; but a great deal of it was also due to the fact that specifications call for special apparatus, or methods of construction, where standard apparatus and methods would do equally well. This experience I find is common among electrical manufacturers, and I attribute it largely to lack of touch between the manufacturer and the engineer drawing the specifications, whether he be regularly employed by the purchaser, or retained in an advisory capacity. Let the engineer see more of the manufacturer and his work and let him hold the latter responsible for results, as determined by proper tests, leaving the details of construction where they belong, in the manufacturer's hands.

This brings us to another phase of the subject, viz.: the tests and guarantees prescribed by specifications. Omitting from consideration matters which as already stated belong properly to the designer and builder, such as current densities in the windings or in brushes, methods of insulation, kinds of material, etc., etc., the tests necessary to determine a machine's quality (and hence its value to the purchaser) are few in number and can be enumerated under the headings of efficiency, heating, regulation, sparking and insulation. If the requirements under these five headings were formulated under some general rules, and if the methods of tests to determine results were uniform, the work of the consulting engineer and the manufacturer would be vastly lessened. Such, unfortunately, is not the case, and specifications on these points vary widely both as to requirements and as to the method of test. It seems practically impossible for the various manufacturers and consulting engineers to standardize these requirements and tests by any concerted action, and the only other solution of the difficulty is for some scientific, non-partisan organization to undertake the work. The American Institute of Electrical Engineers is just such a body, and it would render a great service to the entire electrical business if it would consider the matter. Without attempting in any way to suggest what action it should take, it seems proper to call attention to some of the points which most frequently give rise to misunderstandings and disputes.

1. Efficiency.—The proper distinction between electrical and commercial efficiency is not made. The latter is what interests the purchaser and it should always be specified. A clear statement of what losses must be included to determine it, and also a general statement of what constitute reasonable

and proper commercial efficiencies in well designed machines would be of great service. Such a statement should show the necessary difference between carbon and copper brushes, and between the voltages most commonly used in direct current work, viz.: 125, 250 and 500 volts, as well as between machines of various sizes. The formulation of such information on alternators is more difficult, but all manufacturers have certain standard lines of these machines and it is quite possible to make some intelligent general rules.

Electrical manufacturers are sometimes required to guarantee the combined efficiency of generator and engine (or other prime mover). This is clearly unfair and shifts the direct responsibility of guarantee from the maker of the prime mover, where it properly belongs.

2. Heating.—For all ordinary conditions of service, the safe heating limits for continuous full load operation can be determined with a fair degree of accuracy. The commutator heats more than any other part of the machine, particularly with carbon brushes, a fact which is often ignored. Sometimes the heating is measured by thermometer, sometimes by increase in resistance. There should be one uniform method followed. Overload guarantees (ranging from 25 per cent. to 100 per cent.) are sometimes required for a period within which the ultimate temperature of the machine is reached, and the necessary capacity of the machine is thus increased as certainly as though a larger machine were specified. It would seem that the time duration of overload tests should bear some relation to service conditions. If the service requires a 50 per cent. overload for eight hours or more, a larger machine is evidently necessary.

3. Regulation.—Specifications frequently call for a straight line compounding curve, a condition which is practically impossible until we discover a magnetic material which has a straight line saturation curve. Another common requirement in the case of lighting generators, is that a drop of, say, 2 per cent. in speed shall not affect the electromotive force more than 2 volts, which is also an impossible condition, even with a separately excited generator. A reasonable margin in either case, having due regard to the service for which the generator is intended, should always be allowed.

4. Sparking.—Modern design, and the use of carbon brushes, have greatly reduced the trouble from sparking, but machines are sometimes called upon to stand excessive overloads without sparking, which can be accomplished only by using a larger machine or by a distortion of design, which is bad practice. Any good machine, with carbon brushes, should be able to stand a variation from no load to full load without movement of brushes and without noticeable sparking; it should also stand a reasonable overload, say, 25 per cent., without injurious sparking.

5. Insulation.—This is a cause of frequent trouble and annoyance. The common practice is to specify an insulation resistance of so many megohms, regardless of the size of the machine and the voltage and conditions of service. Considering the fact that this resistance varies inversely as the area of surface to be insulated, and considering the enormous variations in size, shape, voltage and service requirements of different machines, it is evident that such a test is impracticable and means little or nothing. Insulation resistance is largely a question of dryness, and if an armature be baked for a sufficient length of time, almost any resistance within reason can be obtained. I have known a large 400 kilowatt lighting armature to measure a megohm resistance, as required by specifications, after several days' baking (which, by the way, permanently injures the structural strength of the insulating material) and yet it showed practically no resistance when it reached its destination, because it had been in the rain and dampness for a week or more, and the large surface naturally afforded an excellent lodging place for moisture. A day's run in a weak field, with the armature short circuited, quickly brought the insulation up again.

The only proper way to insure good insulation, with reference both to the material used and the method of construction employed, is by a high potential test applied when the machine is reasonably dry. This test should be intelligently gauged by the voltage of the machine and the service required. Thus a high potential test of 1,000 volts is ample to detect any insulation weakness in a 125-volt lighting generator, while a 5,000-volt test is ample for a 1,000-volt alternator, allowing proper factor of safety in each case. Recent careful investigations have developed the fact that the only correct way in which to determine the proper high potential test for any given machine is to consider jointly the time duration of test, the current frequency and the voltage of machine. As the latter rises, the margin between it and the test voltage necessarily decreases on account of the liability to permanent injury of the insulation when subjected to excessive voltages. Because 5,000 volts is found to be a proper test voltage for a 1,000-volt machine, it by no means follows that 50,000-volts is proper for a 10,000-volt machine, or that the apparent factor of safety should be the same as the voltage rises. There should be a careful formulation of proper high potential tests for different classes of apparatus, based upon scientific investigation and tests, and it is believed that it would not be a matter of any great difficulty to formulate such a schedule.

It is earnestly to be hoped that the Institute will consider that these questions come properly within its sphere of action, and that it will take action in a matter of so much moment to all concerned. It should be remembered that where special conditions are imposed which lead to distortion of design or to the manufacture of special apparatus, the purchaser, no less than the manufacturer, is bound to suffer, and it is the purchaser who pays the bills, directly or indirectly. If the purchaser finds himself involved in unexpected expenditures, the consulting engineer, too, comes in for his share of blame and dissatisfaction.

We come finally to the commercial requirements which have gradually found their way into specifications, and which are sometimes onerous and unfair. Perhaps the most important of these is the question of shipments. It is not uncommon for shipment to be specified by a certain date, under a forfeiture of so many dollars a day for each day's delay thereafter, and the award of the contract is often largely affected by such promises. The manufacturer starts the work in his shops, and if the time is short he is apt to work overtime. About the time the apparatus is ready for shipment, and without any previous warning, word comes to withhold shipment because the purchaser is not ready to receive it. There were recently fifteen carloads of apparatus lying in the yards of one of our manufacturing establishments, besides a number of large machines stored in the shipping and testing departments, which had been made on time contracts and held at the last moment by request of the customer. It is difficult for one not in this end of the business to realize the resulting demoralization throughout the shops, and it is a condition which could easily be remedied by the exercise of more foresight on the part of the purchaser and his engineer. In all cases where a penalty for delay in shipment is imposed, it is fair and reasonable to ask that a similar bonus should be awarded if shipment is made in advance of promised date, or if the purchaser is unable, through no fault of the manufacturer, to receive the apparatus on that date. It is sometimes required that the consulting engineer shall have full access to the shops at all times while the apparatus is in production. Such permission is impracticable if proper shop administration and discipline are maintained, and these visits should be made at certain specified stages of the work. It is, of course, always proper for an engineer to be present when the apparatus is finally tested.

A clause is commonly found in specifications providing that the consulting engineer shall be sole judge of the true intent and meaning of the specifications; and in case of any dispute thereunder his decision shall be final and binding. It is true that this clause is common in architects' and builders' contracts, but it is doubtful whether it could be enforced at law, in case of a dispute as to facts, and it certainly seems fair that in case of such a dispute, where the two parties honestly disagree, provision should be made for a third, disinterested party to act as arbiter.

While there are many contracts executed which involve one or more of the provisions (technical or commercial) mentioned above as liable to cause trouble, and where no trouble is experienced, due to the common sense and good judgment of both engineer and manufacturer, still the cases where trouble does arise are not infrequent, and the best specification is one so fair and so clear that no dispute or misunderstanding can arise, except with malicious intent, and which requires no arbiter to interpret its true intent and meaning.

In conclusion, let us hope that the customer, the consulting engineer and the manufacturer will, in the future, consult each other more freely and frankly, by personal interview or by cor-

respondence; and that all of them will unite in indorsing any intelligent attempt to standardize such tests and technical requirements of electrical apparatus as are matters of common usage in our daily business intercourse.

PERSONAL

Officers of the New Anchor Electric Co.

AMONG the most progressive of the younger electrical firms in New England is the Anchor Electric Company, of Boston, recently reorganized. The president of the company, Mr. George O. Proctor, is a native of Rockingham, Vt., where he first saw the light of day fifty years ago, being descended from the well known old New England family whose name he bears. He obtained his earliest education in Rockingham and later in the Chester, Vt., Academy. Farming and lumbering engrossed Mr. Proctor's attention until 1874, when he removed to Boston, and entered the grain business with his brother, under the firm name of Proctor Bros. This firm is still in existence and is among the largest hay and grain concerns in the vicinity of Boston. Mr. Proctor was honored by an election to the Massachusetts Legislature in 1892, being appointed on the Committee on Street Railways. He was re-elected in 1893, and placed on the Committee on Cities. Mr. Proctor is conspicuous in many social organizations and in Freemasonry circles, and is, besides, a director of the Somerville National Bank; president of the Lynn Trust Company, and a member of the Boston Chamber of Commerce. Mr. Proctor's long business and financial experience is everywhere noticeable in the company's management.

Mr. Guy H. Proctor, vice-president of the Anchor Electric Company, is the son of G. O. Proctor. His first business connection was with the Boston Rubber Company, in whose factory he mastered all the practical details of the rubber business. Thus qualified, he was placed in charge of that company's Chicago branch office, in which capacity he came in contact with the largest buyers of rubber goods in the country. Later Mr. Proctor accepted a position with the Conant Rubber Company, of Boston, whose selling agent he was prior to his connection with the Anchor Company. Besides an inherited business ability, Mr. Proctor has a considerable inventive faculty. Among other devices he designed, in connection with Capt. Samuel Abbott, of the Boston Protective Department, the protective cover now largely in use, and also numerous and valuable improvements in rubber goods. He brings to the Anchor Company the vigor and enthusiasm of youth, with a good business record behind him.

Mr. Norman Marshall, the company's treasurer, was born in Hampstead, N. H., in 1864. At sixteen he entered the office of an architect and civil engineer, thus following an early bent. Desirous of further perfecting himself in his chosen profession, he entered the Worcester Polytechnic Institute, from which he graduated as civil engineer in 1886. Immediately thereafter he entered the service of the Marr Construction Company, and took an active part in the erection of some of the earliest Edison stations in the country, finally becoming superintendent of the Marr Company. Among the stations erected under his supervision were those at Altoona, Pa.; Dayton and Columbus, O.; La Crosse, Wis.; Birmingham, Ala.; Fort Worth, Gainesville, Marshall and Houston, Tex. On his return from Texas, in 1889, Mr. Marshall took charge of the Marr Co.'s New England office, and later was appointed district engineer of the Westinghouse Company for New England. Desiring to engage in manufacturing, Mr. Marshall resigned his position in 1892, and organized the Iona Manufacturing Company, in Philadelphia, which in 1894 removed to Boston. From a plant employing a dozen men the business was increased until upon its merging with the Anchor Company, three years ago, it carried fifty employés on its factory pay rolls. Mr. Marshall's attention has heretofore been exclusively engrossed by the factory, but he now assumes, in addition, the duties of the treasurer and the company's financial management. We may add that the Anchor business has doubled since its organization three years ago.


George O. Proctor.


Guy H. Proctor.


Norman Marshall.

A Farewell Dinner to Messrs. Murray and Kimball.

It having been decided to remove the accounting department of Westinghouse, Church, Kerr & Co. from their New York to their Pittsburg office, and as this necessitated the change of residence from the East to the West of those who are in charge of this department, the engineering force of the company tendered a farewell dinner to Messrs. Warren L. Murray and Gardner W. Kimball on the eve of their departure on January 5. The affair was held in one of the private dining rooms of Mouquin's Fulton street restaurant, and was planned as a surprise for both guests, proving a most enjoyable affair in all respects. Plates were set for twenty-two, there being but a single absentee who was out of town. Mr. Walter C. Kerr, vice-president of the company, sat at the head of the table, with the two guests of the evening on either side, and Mr. Otis L. Williams, treasurer, at the other end. The bill of fare had been gotten up by several of the brightest members of the engineering force, who substituted mechanical for the usual French terms, to the amusement and in some cases to the consternation of their brother engineers. After the dinner had gotten well under way, Mr. Williams as toast master allowed no individual to escape, and there were in consequence twenty-one responses in regular order, besides several which were interpolated.

Mr. Kerr, in a few early remarks, expressed his pleasure at meeting the force in this form for the first time, and suggested that an annual dinner, or, perhaps, one more frequent, would not be a bad idea.

Mr. Murray has been in the employ of Westinghouse, Church, Kerr & Co. for fifteen years and Mr. Kimball nearly as long, and the New York office felt great regret at their leaving the East in the call of duty. A number of presentations were made to the two departing guests as tokens of esteem from their fellow-employés.

SOCIETY & CLUB NOTES

A Notable Meeting of the New York Electrical Society.

(Arrangements made with the Electrical Exhibition.)

ON January 12, the New York Electrical Society had its 184th meeting at the College of the City of New York, where most of its meetings this season will be held. President Dr. M. I. Pupin, of Columbia University, was in the chair. Mr. S. Dana Greene read a valuable and interesting paper on "The Relations Between the Customer, the Consulting Engineer and the Electric Manufacturer," printed elsewhere in this issue. The aim of Mr. Greene in this paper was to assist in bringing about that better understanding between these departments of the industry, on which so much of its welfare and prosperity depends.

Messrs. Max Osterberg, Gano S. Dunn, C. O. Mailloux, H. B. Coho and Drs. C. E. Emery and F. B. Crocker took part in the discussion.

The following resolution was duly presented and adopted:

Resolved, That in view of the excellent suggestions and recommendations on standardizing apparatus embodied in Mr. S. D. Greene's paper, the society hereby express its approval of efforts in that direction, and invites the American Institute of Electrical Engineers to consider some comprehensive plan for such standardization of American apparatus for electric light and power."

The new members elected were Otto Rothenstein, F. K. Vreeland, F. V. Henshaw, S. L. Griswold Knox, John Neilson, Putnam A. Bates, E. E. Higgins, Thomas A. Edison, Jr.

At the request of President Pupin the secretary, Mr. G. H. Guy, read the following announcement:

"For some time past the New York Electrical Society has been considering means for enlarging its scope of usefulness. and addressing a larger clientage among the citizens of New York, so as to bring the public into more intimate relations with the scientific aspect of all classes of electrical work. The proposition to hold an Electrical Exhibition at Madison Square Garden next May appeared to the Society to afford it the needed opportunity for putting itself prominently before the public, as the oldest electrical body in the country, and the recognized local Society, aiming by papers and discussions to diffuse the best electrical information.

"The Electrical Exhibition has very promptly and generously met the views of the New York Electrical Society, and has not only apportioned it space in the exhibition hall, for a booth and rendezvous for its members and friends, but has also placed at its disposal a contribution of funds for its educational work. This amount will be increased by a percentage of the admission receipts of the Exhibition, which is to be held 'under the auspices of the New York Electrical Society.' Members of the Society will be admitted to the Exhibition at half-price.

"It is believed, from what is already known, that this Exhibition will surpass anything of the kind ever done in this city, and will during the continuance of a month, not only do much to promote electrical interest, but enable the Society to reach a great many thousand people who should know of its work, and many hundreds who should unquestionably be in its membership.

"The Electrical Society is now organizing committees, and laying plans for a hearty and active co-operation in the work of the Exhibition, and looking, of course, to its own increase of membership and its fuller recognition as an authoritative, influential body.

"It is hoped and expected that this will mark the beginning of one of the most successful moves ever undertaken by the Society, and approving comments of friends and members encourage the Executive Committee to believe that they will be enthusiastically supported in the programme, the sole object of which is to increase and extend the Society's usefulness. The officers would, therefore, not only urge the members of the Society, individually and collectively, to assist in making the Exhibition as brilliant a success as possible, for the direct benefit that such success will confer on the Society, but wish also to impress on members the desirability of active co-operation with a view of increasing the membership (a membership which, now standing at 400, should be at least 1,000 before the year is out).

"It has been suggested that the Advisory Committee of the Society, representing its interests with the officers of the Exhibition, and for other exhibition purposes, should consist of the present officers and all the living ex-presidents, namely, Messrs, Francis W. Jones, John M. Pendleton, Dr. Francis B. Crocker, Joseph Wetzler, C. O. Mailloux, John W. Lieb, Jr., Dr. C. E. Emery, all of whom, it is understood, will gladly co-operate in this movement to develop work, to which they themselves have so actively contributed in past years."

The following resolution was put to the meeting and unanimously adopted: "Resolved, That having heard the report of the officers of the Society, in regard to the arrangement effected for co-operation with the approaching Electrical Exhibition in this city, the members hereby express their hearty approval and pledge themselves to active work, that shall make the most of this opportunity for promoting the interests of electricity and the welfare of the Society."

Henry Electrical Society.

The next meeting of the Henry Electrical Society will be held at Columbia University, Engineering Building, Room No. 302, on January 21, 1898, when Mr. D. R. Lovejoy will deliver a lecture on "The Induction Coil and High Potential Discharges." The lecture will treat of the practical design of the induction coil and will be illustrated by many experiments showing the various effects obtainable.

THE STOCK MARKET

A Strong Front to Business.

All the favorable business conditions noted of late remain in full force, and have had such an effect that the stock market has scored some remarkable advances, despite genuine uneasiness about the desperate situation in Cuba and Spain. Railroad earnings for December of leading roads, increased 13 per cent., while for the year 111 roads, with 100,000 miles of track, showed 7.5 per cent. increase over 1896. The Northwestern roads are already beginning to feel the Klondike spring rush, which bids fair to swamp them. Bank clearings for the first week in January gained 37 per cent. over the 1897 week, and 56 per cent. over 1894. Business failures were only 323 as compared with 478 in the first week of January, 1897. The iron market is conspicuously active and hopeful. Export trade continues large. Such indications speak for themselves as to the general revival, while the great easiness in the money market is creating an immense demand for investment bonds and good stocks.

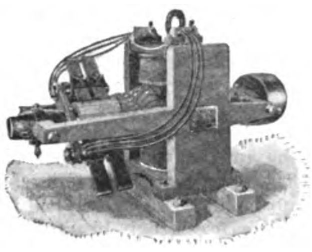
During the week, 39,918 shares of Western Union were sold around 90⅝ to 93⅝, and 17,060 of General Electric from 34 to 36. Bell Telephone is again very strong on the Boston market, and went up to 271 on sales of 665 shares.

Copper shows a rising tendency and was up to 11 cents last Friday. Steel rails are quiet at $18.

Kessler & Co., of New York City, offered last week at par $250,000 8 per cent. preferred stock of the Electric Vehicle Company, the issue having been underwritten by a guarantee syndicate. The authorized capital stock of the company is 50,000 shares of 8 per cent. non-cumulative preferred stock of $100 each, and 50,000 shares of common stock of $100 each. Six hundred shares of the preferred stock have already been issued, 2,500 shares are now offered, and the rest remain in the treasury of the company. The entire amount of $250,000 is to be expended for the benefit of the company, no part of it for patents, franchises or underwriters' commissions. Any dividends declared after the common stock shall have received 8 per cent, are to be divided prorata between the common stock and the preferred stock then outstanding. The subscribers will receive, in addition to each share of preferred stock, one share of full paid non-assessable common stock.

TRADE NOTES & NOVELTIES

The Mayer Motors and Lighting Dynamos.



We herewith illustrate the Mayer motors and dynamos, manufactured by Maxwell M. Mayer, Second avenue and 121st street, New York City. Although his plating dynamos have been in the market for over three years, and are well known as standard apparatus in that line, he has but recently gone into the manufacture of motors and lighting dynamos on any scale, although quite a few are running for a number of years. These machines are built on the same general lines as the plating dynamos, having a two pole iron-clad steel frame, cast in one piece with removable field coils. The armatures are of the slotted drum type, finely laminated to avoid heating. The commutators, which are of ample proportions, are made of tempered copper and insulated with sheet mica. The brushes are carbon in a self-feeding brush holder. The mechanical construction is of the very best. The shafts are large and run in self-oiling bearings. The machines are efficient, smooth running and noiseless, are made to last, and will no doubt meet with as much favor as the plating dynamos of the same make. They are built in four sizes from ½ to 4 k. w.

G. E. Improved Slow and Moderate Speed Belt Driven Generators.

The General Electric Company announces in a recent bulletin a line of new and improved slow and moderate speed belt-driven Generators, former types of which have proved so uniformly successful and efficient that they have come into very extensive use for both lighting and power purposes. The features of excellence which have tended to this result have all been retained, and the new line, somewhat different in appearance, embodies also all the improvements suggested by experience with the older types.

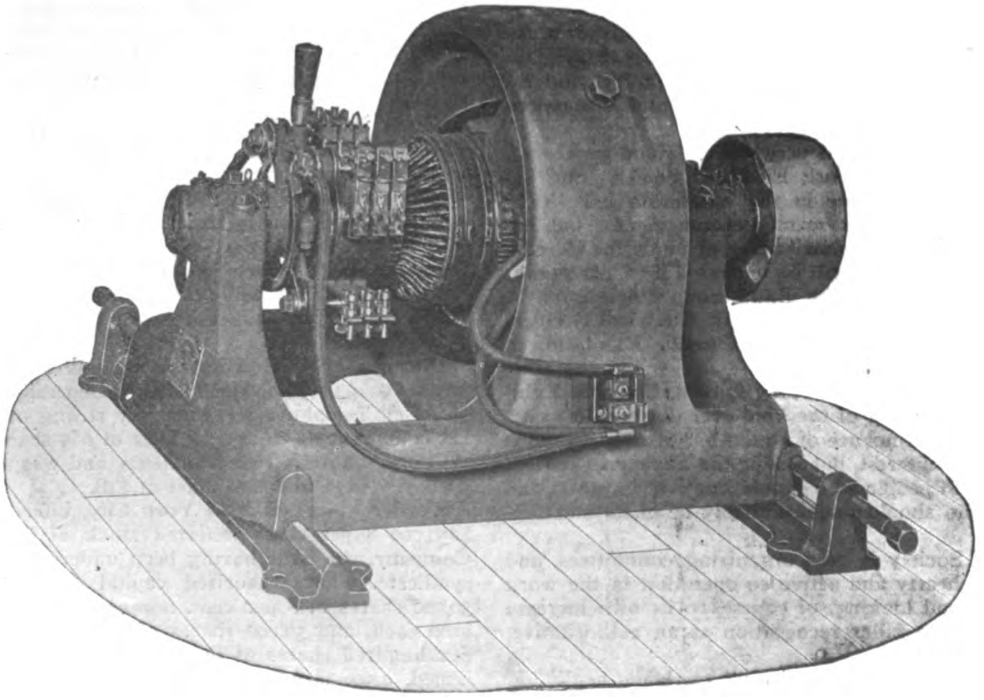
These machines are of the four-pole type. This construction allows of an extremely economical distribution of the magnetic material, while by shortening the magnetic circuits the exciting current is reduced and the efficiency increased. Reduction in speed implies increase of weight if the same output and efficiency are to be obtained, but low speeds with small weight per k. w. is possible in these machines owing to the economy in material effected by the adoption of the four-pole type. As the frames are of the highest quality of iron and the pole-pieces of special soft steel, these generators are lighter than even others of the same output but higher speed.

The floor space occupied is small; the frame is strong, rigid and graceful, and the dimensions are as small as possible consistent with stability. The mechanical construction of the bearings, shaft and oiling devices is such as to make the operation of the machines safe and easy, even to unskilled attendants. The comparatively low belt speed even in the smallest machines, results in less wear and tear of belts and bearings and noiseless running.

The pole-pieces are of special soft steel of the highest magnetic permeability. As they are detachable from the frame, the field coils are removable without disturbing the armature. The armature is built up of japanned sheet iron laminations assembled on a cast iron spider. Air ducts separate the laminations into groups and provide for thorough circulation through the windings, core and spider. The windings are copper wire coils, formed and insulated before assembling on the core.

These generators are sparkless and the brushes being of carbon require no shifting in changing from no load to overload. The only wear on the commutator is that due to friction, and the use of carbon brushes reduces this to a minimum. The rise in temperature in any part of the machine, except the commutator, will not exceed 45 degs. C., after continuous full load run of ten hours. The temperature rise of the commutator under the same conditions will not exceed 55 degs. C. All parts of the machine are interchangeable, and as the substitution of new parts requires no special skill or knowledge, any change can readily be made by the attendant.

The four-pole machines of the slow speed type are built in capacities from 6.5 k. w. to 75 k. w.; of the moderate speed type from 9 k. w. to 85 k. w. They are wound for 125, 250 and 500 volts. Many of them can be adapted for direct coupling to engines by mounting the machine on an extension of the engine bed, and connecting the armature to the engine shaft through a coupling.



NEW G. E. BELTED MEDIUM AND SLOW SPEED GENERATOR.

MR. F. M. LAUGHLIN, prominent in the Solar Carbon Co., of Pittsburg, was a busy visitor to New York this week.

Menominee 1898 Fans.

The Menominee, Mich., Elec. & Mechanical Co., manufacturers of general electrical supplies and fan motors, are making an entirely new design for their 1898 fans, in which beauty and high efficiency are taken into consideration, as well as the necessary and essential features of high efficiency and durability, which are just as fully kept in view as ever. Mr. Henry Tideman writes us that they have taken special pains this year to design a motor of high art and finish. Two dolphins of artistic design, resting on a fantastic base, hold the motor, which can be swung into any desired position. The effect is very charming and pleasing. All the machines are nickel plated in every part. The company will be glad to receive inquiries on the subject.

Recent Large Sales by Walker Co.

The Walker Company is now building at its Cleveland works a 1,600 k. w. direct connected generator for the Union Railway Company of New York City. This, with the two now being completed for the Brooklyn Heights Railroad Company, will make three of these 1,600 k. w. machines finished in as many months. In addition to this generator for the Union Railway Co., the Walker Company is building for them 40 double No. 4-A street railway equipments. The equipments are to be fitted with the new type "S" solenoid blow-out controller which has attracted so much attention. The current for these motors will be fed to the line from a Walker switchboard, now being built at New Haven.

The Metropolitan Street Railway, of Kansas City, which is now operated by a 1,600 k. w. Walker generator, is about to increase its plant by the addition of a generator of 1,200 k. w. capacity, and as a contrast to these immense machines it may be mentioned that the company is building a 25 k. w. lighting generator for Mr. J. J. Astor's new yacht.

The foreign shipments during the next few months will include 100 double 3 S street railway equipments, with 200 controllers, for Dresden, Germany; 6 double 3 N equipments with Type "S" controllers, and two double 3 N equipments.

Besides these railway motors and accessories there will be one 150 k. w. belted railway generator with its switchboard and a 75 k. w. belted booster for Japan, also with a switchboard.

This makes over 7,500 h. p. in street railway motors alone that are being built at the Cleveland works, to say nothing of the horse-power output in generators.

Warning Against a Sharper.

We have received a communication from Messrs. E. P. Roberts & Co., of Cleveland, requesting us to warn the engineering profession against a sharper operating under various aliases. His favorite method is to obtain money on bogus checks on a Utica, N. Y., bank, under the plea of having lost his pocketbook.

The man is described as apparently having considerable engineering information, and to be very shrewd and a good talker. He is about 45 years of age, 5 feet 8 inches or 5 feet 9 inches in height and probably weighs about 170 to 180 pounds. He is thick-set, carries himself erect, and has a quick, brisk walk. He has a dark complexion, dark hair, streaked with gray, a very square jaw and when last seen had a small pointed beard and moustace streaked with gray. A most prominent characteristic is a mark on his forehead resembling a burn or a bruise. The mark is approximately circular and about one inch in diameter.

SOUTHERN NOTES

MR. GEO. A. CRAGIN, agent of Washburn & Moen Mfg. Co., at 1015 Franklin avenue, Houston, Tex., favors us with a neat leather double pocket purse, in which money can be kept securely as long as his company's specialties are kept out of sight.

THOS. H. DALLETT & CO., Philadelphia, Pa., manufacturers of machine tools, have recently installed in the Brooklyn Navy Yard several of their portable electric drills. They manufacture also hand drills, electric portable planers, flexible couplings, etc.

WESTERN NOTES

MR. GEO. P. REX, Chicago, manager of the Columbia Incandescent Lamp Company, St. Louis, has recently closed some nice orders for lamps, among them being a contract for 15,000 Columbias for a large isolated plant in Chicago. The Columbia Lamp Company are working night and day to meet the increasing demand for their celebrated product.

THE OMAHA EXPOSITION is to have a special series of stamps, of a commemorative nature, issued for the occasion by the United States Post Office Department.

ALADDIN LIGHT COMPANY has been formed at Chicago by F. H. Fuller, A. P. Daniel and W. B. Reed, with a capital stock of $10,000 to make electrical goods.

McKINLOCK & CAMP, agents of the successors of the Metropolitan Electric Company, are handling the new Standard dry battery, which is manufactured by Wm. Roche, a pioneer dry battery maker. It is claimed to be superior to any dry battery on the market, and that a sample test will verify this statement.

WHEELER ELEC. AND MFG. CO., Dayton, O., whose dental machine we illustrated recently, have been incorporated under the laws of Ohio, for the manufacture of electrical goods and sundries. The officers of the company are: J. T. Dean, president; W. E. Wheeler, secretary and treasurer.

ACTIVITY IN SUPPLIES.—At this season of the year the amount of iron line material that enters into the business of a large supply house is indeed surprising. The Electric Appliance Company, Chicago, state that they are carrying a stock of these goods that will enable them to make prompt shipments of anything up to a carload, and yet their capacity has been taxed on these goods. The iron mills throughout the country have had a large amount of business this season, and it has at times been very difficult to get iron line material. The Electric Appliance Company, however, anticipated this condition and during the season have been able to keep their stock in shape so that all orders for this material could be shipped promptly. They state that their stock is still being kept up and that customers wanting iron construction material promptly from Chicago stock will not be disappointed.

AMERICAN RHEOSTAT CO., of Milwaukee, Wis., have opened quarters in Chicago, the George Cutter Co. being their agents, 1104 Rookery Building. They are enjoying an excellent demand for their specialties and expect to do even better throughout 1898.

RASTER CARBON RHEOSTAT COMPANY, of Chicago, have just started in business introducing their novel carbon rheostat which possesses many valuable and new features. These people are greatly gratified at the progress they have made in such a short time. They have already got behind in their orders.

MURRAY IRON WORKS, builders of Corliss engines, Burlington, Ia., have issued bonds for the purpose of making additions and improvements in their plant and have executed a trust deed to secure same. They have brought a libel suit for $20,000 damages against a credit agency for stating that the trust deed was to secure preferred creditors. The company say they have no debts and therefore no creditors to prefer.

PHILADELPHIA NOTES

OTTO GAS ENGINE WORKS, Philadelphia, report that they now have installed the two 120 h. p. gas engines for running electric lights at Sisterville, W. Va., and two 50 h. p. engines at Mannington, W. Va., for the same purpose. Business with them is excellent.

CHARLES WIRT.—We have received from Charles Wirt, Philadelphia, copy of pamphlet printed for a Japanese company, which is intended for distribution in the Flowery Kingdom.

MR. H. C. ROBERTS, formerly with Vallee Bros. & Com-

pany, notifies us that he will continue in the electrical trade, and that for the present he can be reached at the Franklin Machine Works, 32 North Fifth street, or 1019 Filbert street, Philadelphia, Pa.

NEW YORK NOTES.

MR. C. R. HUNTLEY, of the Buffalo General Electric Company, was a visitor to New York City last week, deeply interested in plans for power distribution in his city. He states that Messrs. Stillwell, Emmet and Townley have been in consultation there over various aspects of the question.

ROCHESTER ELECTRIC MANUFACTURING COMPANY, of Rochester, N. Y., has been formed with a capital stock of $50,000 to make the cut-out invented by Mr. L. W. Miller. The officers of the company are: President, Hon. W. E. Werner; vice-president, J. M. Kelly; secretary and treasurer, G. A. Brayer; general superintendent, L. W. Miller.

THE FERRACUTE MACHINE CO., Bridgeton, N. J., have just issued a large circular illustrating a number of their presses, and are mailing them to all parts of this country, and a large number abroad. The circular shows a cut of each kind of press, a number of which are especially adapted for electrical work. They will some months hence issue a new catalogue, which will probably be larger and handsomer than anything they have previously published.

MR. MINOR M. DAVIS, a well known electrician, and a tried official of the Postal Tel.-Cable Co., has been appointed traffic manager of that company, with headquarters at the New York main office, 253 Broadway. He is in receipt of hearty congratulations from a host of friends.

MR. A. A. THRESHER, Thresher Electric Co., of Dayton, O., was in New York City for several days past on important power transmission work.

ALBERT B. HERRICK, the consulting electrical engineer and expert, 150 Nassau street, American Society Building, formerly of Herrick & Burke, wishes to notify his clients who wish to consult him without previous appointment that he can always be found at his office on Mondays and Fridays each week; his out-of-town engagements making this necessary.

THORBURN REID, 120 Liberty street, has recently been retained by several large concerns as consulting electrical engineer. Mr. Reid makes a specialty of designing and supervising light and power plants, also designing and guaranteeing the performance of direct current dynamos and motors, alternators, transformers, rotary converters, synchronous alternating motors and induction motors, etc. Mr. Reid solicits correspondence on the subject.

NEW ENGLAND NOTES

THE WALLACE BARNES ESTATE, Bristol, Conn., have turned over the spring manufacturing business to the Wallace Barnes Company, who are now running it under the latter firm name. The management is the same, the manufacturing business being separated from the real estate. The firm report having added several thousand dollars' worth of new machinery to their fast-growing plant, and are now in a position to offer small springs and to do similar special work on order, for concerns in the electrical and allied fields. Inquiries and correspondence are welcomed in regard to goods in this line.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have a contract for a new drawbridge over the South Shrewsbury River, in Monmouth County, N. J. This bridge is to be 180 feet in length and 40 feet wide. The Berlin Company have the contract for both the substructure and superstructure.

W. H. BOWDLEAR & CO.—The insulating compound manufactured by W. H. Bowdlear & Co., 149 Pearl street, Boston, is meeting with good demand throughout the trade.

AMERICAN CIRCULAR LOOM CO., Boston, have issued a pretty colored picture of the old "Constitution" warship, now laid up at Kittery, Me. The picture is from an original by F. Wetherbee.

ADVERTISERS' HINTS

THE PRATT & WHITNEY CO., Hartford, Conn., advertise turret head machines in ten styles and forty-four sizes, with the latest improvements.

THE C. W. HUNT CO., 45 Broadway, N. Y., advertise coal handling machinery of every description, steam and electric hoisting engines, industrial railways, and the famous "Stevedore" manilla rope for transmission and hoisting.

ZIMDARS & HUNT, 127 Fifth avenue, New York, say their knife switches are built for business. Their catalogue and prices may be obtained by writing.

THE PENNSYLVANIA ELECTRIC CO., Marietta, Pa., are making low introductory prices on their telephones, the "Crescent," which they claim to be a strictly up-to-date instrument.

THE CENTRAL TELEPHONE & ELEC. CO., St. Louis, Mo., advertise their instruments as having the latest improvements.

THE UNITED CORRESPONDENCE SCHOOLS, 154 to 158 Fifth avenue, New York, offer a course in electrical engineering which costs the subscriber but seven cents per day.

THE MANHATTAN GENERAL CONSTRUCTION CO., 11 Broadway, N. Y., advertise the "Manhattan" electric projector, with any method of control and of any candle power.

THE HART & HEGEMAN MFG. CO., Hartford, Conn., have something to say regarding the style of contacts and the patent self-adjusting handle embodied in some styles of their switches.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

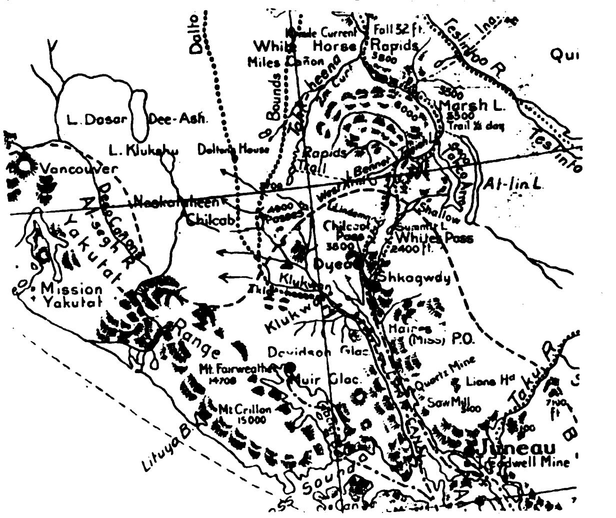
Vol. XXV. JANUARY 27, 1898. No. 508.

POWER TRANSMISSION

Operating Electrically A Klondike Wire Rope Tramway.

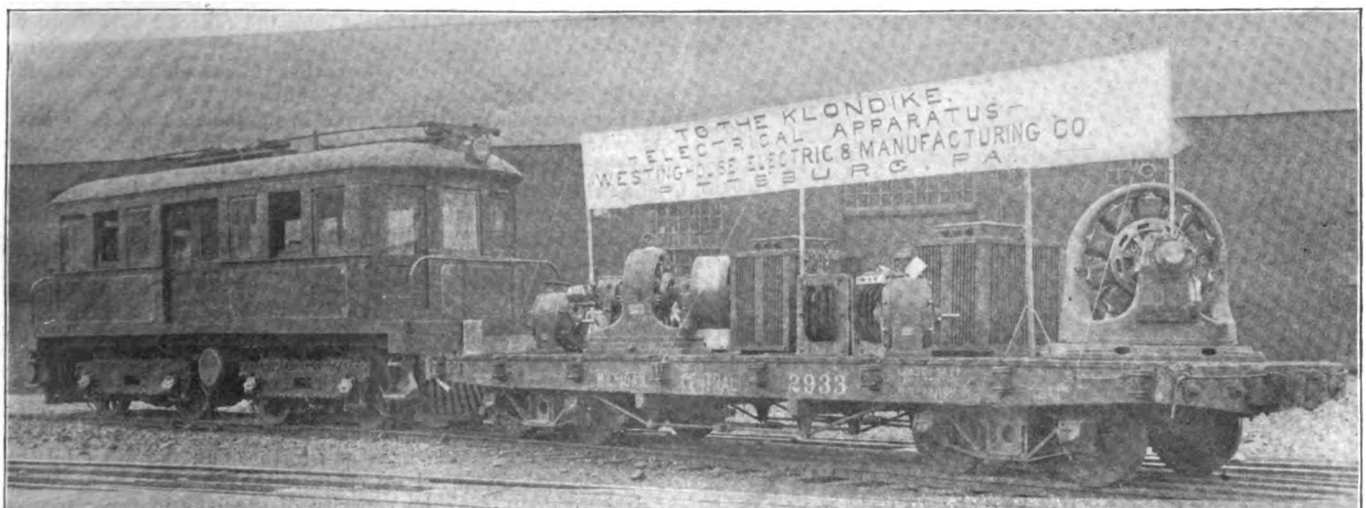
JUST how many people will pour into the Klondike region this spring, to rob its fastnesses of their hidden gold, it is hard to predict; but 100,000 is regarded by those who know as a very conservative estimate. Mr. C. O. Baker, Jr., the well known platinum merchant, who has just returned from the Pacific coast, informs us that he found cities like San Francisco and Seattle thrilling with excitement over the subject, and all kinds of preparations being made by hosts of people to move into the golden land just as soon as there was the slightest possibility of getting there with any degree of safety and certainty. How to get into the region is one of the great problems, even after one has landed on the bleak and inhospitable Alaska shore. There are four overland routes, as we understand it, from that point, and those by the Chilkoot and White Passes are the nearest to the headwaters of the Lewes River, where passengers and freight embark on the long waterway. For the present, the Chilkoot Pass remains the most popular of all the routes, as the all-water route through the mouth of the Yukon River is not much patronized; and there will be a great stream of Chilkoot travel this year.

But how to get over the terribly stiff and troublesome Chilkoot Pass has been a difficult question for everybody until recently, when it was decided to erect and operate a wire rope tramway for the purposes of transportation. In view of the tremendous interest in the subject all over the world, we are very glad to be able to show on this page an illustration of the electrical equipment that has just been shipped off to the Pass, for the Dyea Klondike Transportation Company, and which will soon be in full operation as the motive power for the two tramways along the line of travel. This plant has been built by the Westinghouse Electric and Manufacturing Company, of Pittsburg, and comprises one 45 k. w. two-phase alternator, with the accompanying exciters and switchboard; one 30 h. p. type "C" Westinghouse motor; one 15 h. p. type "C" motor; two 25 k. w. raising transformers and four 10 k. w. step-down transformers. Owing to the icebound nature of the region, steam will be the prime power, but as there is plenty of coal on the coast, the cost of operation should not be high. The distance of transmission is 13 miles. The line potential will be 5,000 volts, three-phase. One of the two tramways will be driven by the 30 h. p. motor, 12 miles from the generator, and the other one mile further by the 15 h. p. motor. In this way, the toil of the gold seekers will be very materially lessened, for one of the well established facts about the Klondike, outside its undoubted stores of gold, is that the Chilkoot



MAP SHOWING LOCATION OF CHILKOOT PASS, NEAR DYEA, ALASKA. (Elevation of Pass 3,500 Feet.)

is one of the toughest pieces of climbing to be found on the American continent. Hereafter, anybody willing to pay the fare, and a good many will be, can be swung along the electrically operated wire rope tramway, which is but one more graphic illustration of the flexibility and availability of electrical power methods.



CARLOAD OF APPARATUS TO OPERATE ELECTRICALLY WIRE ROPE TRAMWAY IN THE CHILKOOT PASS.
(Car Is Being Hauled Through the Westinghouse Yard, Brinton, Pa., by Electric Locomotive.)

The Great Northern Electric Grain Elevator at Buflalo N. Y.

BY O. E. DUNLAP.

THE Great Northern grain elevator built last year in Buffalo is one of the largest structures of its kind in the world, as well as the most novel in design and construction. To obtain great capacity for storage; to handle the grain going in and out with the greatest possible ease and economy was the study of the builders, and this they have accomplished in a manner that commands admiration. This success in construction is largely due to the full conception President J. J. Hill,

of the Great Northern Railroad, has of the needs and requirements of a great elevator, supplemented by the efficiency of D. A. Robinson, the builder.

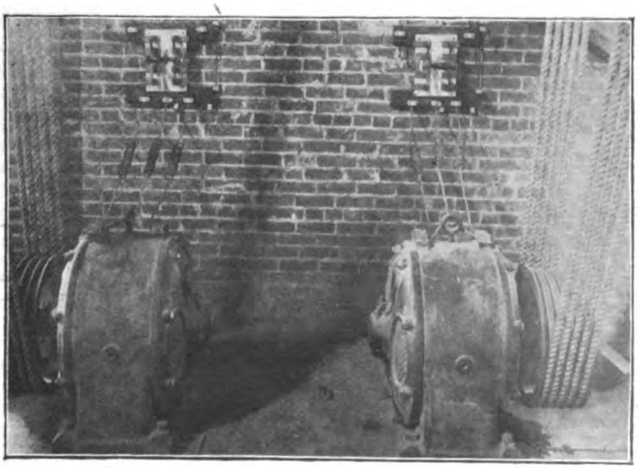
The elevator is situated on Ganson street and the Blackwell ship canal. From the outside its appearance is very like that of other elevators, its size and substantial appearance com-

GREAT NORTHERN STEEL TANK GRAIN ELEVATOR, BUFFALO, OPERATED BY ELECTRICITY.

manding attention. Its length is 396 feet, width 150 feet and height 177 feet. The interior construction is shown in one of the engravings appearing in our issue of August 19, 1897. The storage capacity of the elevator is provided for by large steel bins, cylindrical in form and having cone-shaped bottoms. In all there are 48 of these bins, together with 18 small shipping tanks. Thirty of the bins are 39 feet in diameter, 85 feet high, each having a capacity of 80,000 bushels. There are 18 bins 15½ feet in diameter, 85 feet high with a capacity of 18,000 bushels each. The 18 small shipping tanks are 9 feet 9 inches in diameter and 60 feet high. The combined storage capacity of the elevator is 3,000,000 bushels.

About 600 girders are used to support the bins, the height of the bottoms of the large bins from the ground floor being about 11 feet. The general girder plan is circular in shape after the ideas of Mr. Hill. The steel used in the construction of the bins is from ¼ to ½ inch in thickness, and in their construction about 6,000 tons were used.

The power used in operating the elevator is electricity transmitted from Niagara Falls. The elevator is fitted with 10 inside legs, and each of these is driven by a 50 h. p. motor by means of a rope drive. Each leg is 177 feet high and carries two rows of buckets capable of handling 15,000 bushels of grain an hour. In addition to this each leg has its separate



MOTORS DRIVING CONVEYOR BELTS.

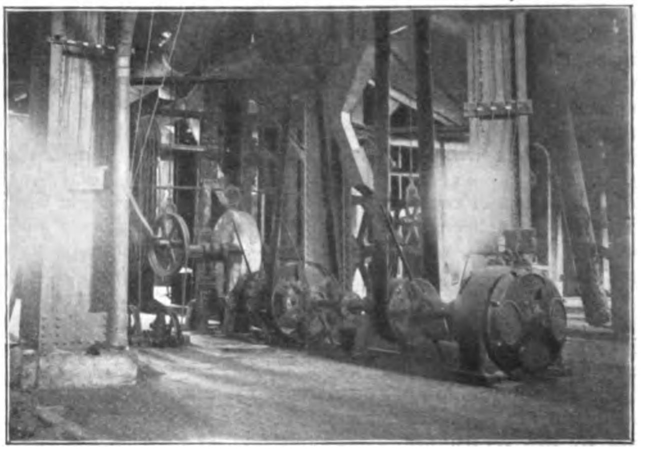
scales and hopper, which weigh the grain before it is stored. All the 50 h. p. motors are placed in a row on the south side of the floor over the bins, and in the line with them there is a motor of 100 h. p. which operates fans and dust collectors. There are also 10 double-jointed distributing spouts connected with the bins and scales, and two similar spouts are used to carry the grain from the cleaners to the bins.

The conveyor belts run along the north side of the building over the bins. They are two in number, each 60 inches wide and 740 feet long, and are said to be the largest belts of the kind in the world, having a capacity of about 40,000 bushels per hour each. They are provided with Robinson's patent reversible self-moving trippers, and are run by two 20 h. p. motors which stand at the west end of the floor. These motors are reversible. On the various floors of the cupola are located the elevator heads, the gearing for reducing speed, 27 steel garners each with a capacity of 1,500 bushels, 10 steel hopper scales, each of the same capacity as the garners.

In looking along the ground floor one sees the great cone-shaped bottoms of the big bins overhead. This floor is paved with brick, and along the north side runs a railroad track slightly depressed. At the west end of the building a spiral stairway leads to the upper floors, while at the east end there is an electric elevator which runs to the scale floor. This elevator is provided with a 10 h. p. motor. The floor is so arranged and provided with openings that it can be flushed at will, the drainage being into the canal at the side.

In the northwest corner a vault-like room is provided for the switchboards, transformers, etc., and in the southwest corner a similar room is devoted to the office of Superintendent John Lane, who is one of the best posted and capable elevator men in the country.

In the center of the ground floor stands a 50 h. p. motor devoted to operating dust collector fans, and operating the



50 H. P. MOTOR AND MACHINERY IN THE CENTER OF GROUND FLOOR.

cable under the building whereby the company are enabled to do their own car switching from the railroad yards and at the side of the elevator by electrical power. This motor also runs the cable by which the marine towers on the canal side of the building are moved back and forth.

These marine towers are three in number. They each have 32 wheels and are operated on two railroad tracks of the standard gauge laid on the dock along the Blackwell canal. The width of dock between the elevator and the canal on which the towers stand is 24 feet. The dock is built of stone, and the towers of steel. Each tower is provided with a marine leg capable of elevating 20,000 bushels of grain an hour, thus the three towers can elevate 60,000 bushels an hour, or 600,000 bushels in a day of 10 hours.

In each tower there is a 100 h. p. electric motor, the switches and starters being mounted over them. Trolley shoes are used, and the current for operating these motors is obtained from three trolley wires which run along the outside of the elevator for its entire length at a height of about 40 feet from the dock. The towers are moved back and forth along the dock by the same method employed on cable railways.

It is evident from the capacity of the legs in these towers that the unloading capacity of the elevator is excellent, but its shipping facilities are none the less so. Double tracks run along the building under a protective awning of steel on the north side, and on either of these tracks nine cars can be loaded at a time, or about 400 cars a day. At the west end a slip provides room for canal boats, by which 100,000 bushels can be shipped daily. Added to this, 200,000 bushels can be shipped daily by vessels on the Blackwell canal side.

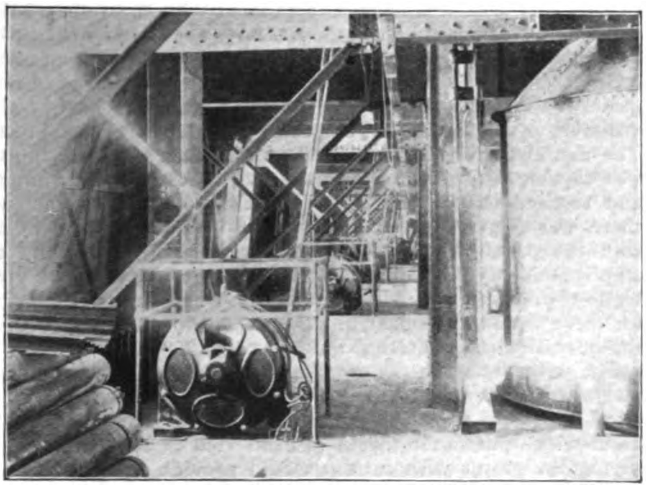
The Cataract Power and Conduit Company are the distributing agents for Niagara power in Buffalo. The power they supply to the Great Northern elevator is transmitted over 30 miles from the point of generation to the point of application. It passes over the pole line to Buffalo at 11,000 volts, and is conducted throughout the city underground to a new transformer station on Ohio street, where the voltage is reduced to about 2,200, and it is at this voltage that it is supplied to the Great Northern Elevator Company.

At the elevator it is passed through two transformers, each of about 600 h. p., and the voltage is still further reduced to 440 volts, at which it is used. The current comes to the elevator at three-phase and is used as two-phase.

Four cables, each of 1,000,000 circular mils, connect the transformers with the main switchboard, which is of white marble and has nine panels. Upon each of these panels are mounted the starting and controlling devices for two of the motors.

The motors and electrical equipment were supplied by the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa. They are of the induction type, 6-pole, 440 volts, and make 500 revolutions per minute. With the exception of the marine tower motors, all the motors are started and stopped from the main switchboard. The motors being sparkless, there is no danger of their igniting the grain dust, which is an important factor of danger about a grain elevator.

The wiring of the building is of open work construction with single wire cleat supports, flexible cable, rubber covered. There are 420 lights in the building, and they are run on the two-phase system. All of them are controlled from the light



LINE OF 50 H. P. MOTORS USED TO DRIVE THE INSIDE LEGS OF THE ELEVATOR.

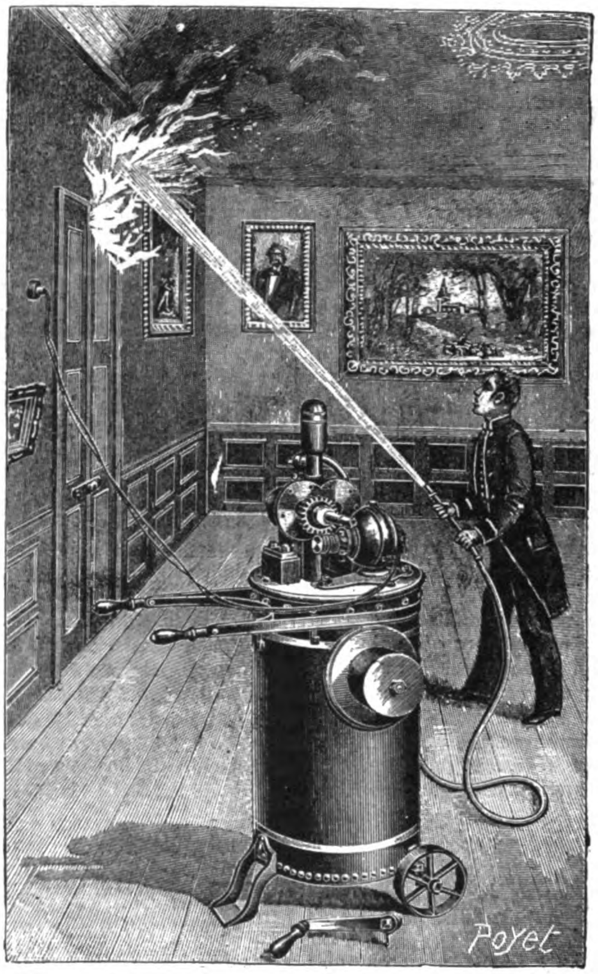
board in the transformer room and by distribution boxes for each 10 lights. A system of call bells and telephones has been established throughout the elevator, and all has worked with complete satisfaction.

The owners of the building are the Great Northern Elevator Company, of which W. C. Farrington, of Buffalo, is president and general manager, and Frederick W. Bobbett, of New York, secretary-treasurer. The plant cost about $500,000, which is but a small part of the Great Northern's interests in Buffalo. It will be operated in connection with the Great Northern Railroad and the Great Northern Steamship Company, the boats of which latter company are the finest on the great chain of lakes. To the business ability of President Hill, of the Great Northern Railroad Company, the world is indebted for this modern, up-to-date consumer of the power of the great cataract.

COLUMBUS, MISS.—The Electric Lighting Co. of Columbus, Miss., write us: "We hand you herewith our check for $4.50 for another year's subscription to The Engineer and for a want ad. We are now installing duplicate machinery—a 100 h. p. Skinner engine and boiler, a 50 k. w. Stanley alternator, switchboard equipment, etc."

The Merriweather Portable Electric Fire Extinguisher.

WE illustrate herewith a very ingenious use of the electric motor for the purposes of a portable fire extinguisher in houses, hotels, factories, etc. It is the design of Merriweather & Son, of Greenwich, England. As will be seen, an



PORTABLE ELECTRIC FIRE EXTINGUISHER FOR INTERIORS.

iron-clad motor of the Lundell type is mounted on top of a small rolling tank which will hold about 120 liters of water or extinguishing chemical, and it can be plugged into any floor or wall receptacle at a second's warning; when the pump at once begins work and directs a sharp, strong stream against the incipient blaze. The motor need be of but small size, and the capacity of the tank also need not be considerable as it can obviously be replenished or else the fire will have attained proportions beyond the ability of any small house apparatus.

Prices for Street Arcs in New York City.

The New York Gas Commission met recently to decide on the city lighting for 1898. The Brush Company was awarded 975 arc lights at 40 cents a night each. The Mount Morris Company got 630 arc lights at 40 cents a night each and 194 arc lights at 45 cents a night each. The Manhattan Company got 840 arc lights at 40 cents a night each and 10 lights at 50 cents a night each, 100 incandescent lights at $1.87½ a month each and 24 incandescent lights at $2.50 a month each. The Harlem Company got 66 arc lights at 40 cents a night each and 19 arc lights at 50 cents a night each. The North River Company got 1,052 arc lights at 40 cents a night each. The Edison Company got 360 double lamps at 50 cents a night each and 524 arc lights at 40 cents a night each.

PROF. LENARD, of Heidelberg, who first discovered the cathode rays, has received from the French Academy of Sciences its prize of 10,000 francs.

ELECTRIC LIGHTING

Circuit Breakers and Their Use in Power Transmission.

BY W. H. TAPLEY.

Chief Electrician U. S. Government Printing Office.

When the application of individual electric motors to driving machinery became firmly established in the manufacturing world, and was conceded to be a more economical method of power transmission than belting with long lines of shafting, second only to the motor, and how properly to connect it to the machine which it was to operate, was the subject of suitable protection both to motor and machine.

The first thing that suggested itself, and naturally, was to protect the motor in the same way as lighting circuits, namely, to introduce a suitable fuse. This was done, and where motors were belted, the results attending overloads were rather of an annoying and aggravating nature than anything which could really be called serious; yet when gearing and the direct application of armature to the main driving shaft of a machine began to supersede the belt, it was only a short time before the fact that a fuse was not an adequate protection became forcibly impressed upon the advocates of electrical power transmission.

As the art advanced, the thing to which the electrical engineer would turn for a rational solution of the problem was the electric current itself. How well this has been accomplished is shown by the successful introduction of the circuit breaker, now so universally used in all large power plants. That the magnetic property of the electric current was the means best adapted for the actuation of the protective device, and gravitation the most reliable force for governing its operation, is seen by the great superiority of the circuit breaker which depends entirely upon these forces, over those in which the effect of the actuating current is subject to variation due to extraneous conditions.

PROTECTION AND WHAT IT SHOULD BE, AS APPLIED TO A LARGE MANUFACTURING PLANT.

In treating of this subject the tendency of the engineer has been to regard it almost entirely from an electrical point of view, incidentally, if at all, considering that which affected the real success of the manufacturing establishment employing motors; namely, constant service and lowest cost of production. Before entering further into this matter, let us see what is absolutely required to give a manufacturing establishment protection worthy of that name, when using electrical power transmission.

First: To secure protection of the electrical apparatus from motor to generator.

Second: To provide a method which will afford ample protection for the machinery to which electric motors are attached.

Third: To secure a freedom from interruption of production, and avoid the exasperating delay which is experienced in replacing any part of the protective device after the same has been called into service.

Fourth: After protecting everything in the shape of machinery, the safety of building and electrical apparatus and providing against the stoppage of production; the matter of reducing to the lowest possible point the liability of accident to the operators required to handle either motors or machinery must be considered, as indeed this is a matter of supreme importance.

That all the above mentioned features are ever present, confronting the engineer, who is responsible for the successful operation of a manufacturing plant, is confirmed by the large number of so-called protective devices already offered to the public.

At present a very large part of the labor of the electrical engineer and the manufacturers of this kind of electrical apparatus has been directly in one line, that of protecting the electrical apparatus from the effects of over-heating and the building from fires which might occur from heavily overloaded circuits.

As this feature is commanding a large share of attention in the electrical press and manufacturing world, it would seem best to devote our time in this article to the field suggested in the last three of the foregoing propositions, which, if satisfactorily solved, of necessity cover all the ground now under consideration by engineers, on the subject of proper and positive protection to electrical apparatus as applied to transmission of power.

The pronounced success during the past two or three years of the direct application of electric motors to all kinds of machinery has put this method of power supply so far in advance of other methods, that, notwithstanding the comparatively high first cost, it is now considered the most economical method and should be adopted by every large manufacturing plant where the work is, in any sense, of an intermittent nature.

Let us now look from the electrical side to that of the manufacturing plant, proper, and see if protection is not even more important and imperative here, where very much larger sums of money are invested, and until now have been wholly neglected except by insurance from fire.

To suggest something which may form a topic for discussion, let us take the case of a printing press to which is directly connected an electric motor. The cost of the printing press is, roughly speaking, $3,000.00, and that of the motor equipment $300.00. (These are nominal figures which vary with the class of press used and character of work required from it; the cost of motors also varies considerably, but these figures are conservative and fully within the figures for which good apparatus can be purchased.) Allowing the electrical to be one-tenth the cost of the mechanical installation, does it not seem strange that it has always been the motor which it has been the sole idea of the engineer to protect, notwithstanding that its cost is insignificant as compared with the value of the machine to which it is attached? Is it any wonder that the manufacturers of costly machinery, such as printing presses, have looked with doubtful eye upon the method of direct motor application, whether it be by gearing or having the armature of the motor keyed to the main shaft of the press? The manufacturer well knew that for a short time the motor was capable of producing perhaps five times its rated output, and realized that if this period covered only a few seconds there was a great probability that it would be sufficient to ruin the press should anything occur which would tend to stop it suddenly. He did not feel that there was even the protection which is afforded the presses when driven by belts, for these would slip when called upon to do much more than the normal work of driving the press.

The writer takes the same ground as the machinery builder, and when the representatives of companies manufacturing electrical apparatus were asked about this matter, they invariably assured the purchaser that a fuse inserted in the circuit supplying the motor with current would provide against all possible trouble of this kind. It was tried; the fuse worked in some cases and we began to take courage, thinking that perhaps we were too particular and that the fuse afforded the required protection. It was seen, however, that the blowing of the fuse might serve to protect the motor but not the press.

It is impossible to change over from one method of operating machinery to another without meeting failures, due perhaps to nervousness on the part of the operator when called upon to do a thing for the first time; and certainly it was so when motors were first used in this manner. The sudden turning on of the controller naturally blew the fuse, which too often was sufficiently increased in size to prevent this annoyance. But at its best the fuse served only to protect the motor, the requirements of the motor-driven machine being altogether overlooked. To better appreciate the shortcomings of the fuse in this respect, it is only necessary to understand the conditions under which it operates to open the circuit in which it may be placed.

The effective energy which must be supplied to the fuse is made up of the following quantities: First, heat sufficient to raise the temperature to that of the melting point of the fuse; and, second, an additional amount of heat proportional to the mass and latent heat of fusion of the fuse, while in addition to this, the heat, being radiated by the fuse and its terminals, must be supplied. It will be seen from a consideration of these facts, that the fuse requiring a relatively large excess of energy to effect its operation, will permit a proportional excess of

power to be supplied to the motor. The damage which may result from this may perhaps be more readily seen by an example. Suppose a foreign body gets into the working parts of a machine which is directly connected to a motor. The power supplied by the motor is now expended in the wrecking of the machine, the weakest parts yielding first to the strain. Only a very short time is necessary for the execution of great damage. The possibility of damage is then limited only by the energy required to blow the fuse.

It was only upon the advent of the modern circuit breaker that protection worthy the name was secured for motor-driven machinery. Owing to the much lessened energy required in the operation of this device, the time required upon the occurrence of an abnormal flow, for the opening of the circuit, is minimized, while, in addition to this, the heavier overloads are made to contribute some of their energy to the acceleration of the circuit-opening switch, thereby still further decreasing the time of opening.

It may thus be seen that by the use of a properly constructed circuit breaker, the excess of power which may be communicated to the machine is vastly reduced as compared with the fuse. In fact, the time element is so lessened that the possibility of damage to machine as well as to motor is practically limited to that due to their combined momentum. What this is in each individual case, makes it necessary to decide whether an auxiliary break to take care of the same is necessary or not. This is a question for the mechanical engineer to solve, but, whatever this may be, it does not affect the principles set forth above, and only serves to bring out more clearly how necessary it is to shut off the current instantly and thus prevent the machine from acquiring any additional momentum.

As the question of machinery protection has been given so little consideration, it was deemed advisable to bring to the reader's notice, in rather a minute way, all the possibilities that it may have, in order to give to the subject the importance which we feel it deserves. In the foregoing, a reference was made to the comparative cost of a printing press and that of the necessary electrical equipment to drive the same; i. e., $3,000.00 for the former and $300.00 for the latter—a relative value of ten to one, which justifies the statement that the protection of machinery is a much more important consideration in electrical transmission than that of the motor. Can the electrical engineer afford to neglect this important feature of machinery protection and still hope that his customer will secure satisfactory results? For, after all, it is necessary that the new system as a whole shall be made more productive, and thereby more profitable, than the old.

It may be assumed that our third proposition is intended more especially for the manufacturer than the engineer, but, taking the ground that that which is of importance to the buyer concerns the seller also, we believe it is worthy of the close attention of both. As the writer has had an extended experience upon the application of electricity to printing machinery, he hopes to be able to treat this branch of a manufacturing business in a more positive manner than he could do should he endeavor to extend its scope into a more general or theoretical field.

Referring once again to the printing press, with its electrical equipment cost (which we assume to be respectively $3,000.00 and $300.00), let us see what the production of such a press should be when it is running for three hundred days in the year on a fairly good class of printing, and what costly affairs stoppages of presses are, no matter what the cause. A press should earn an average of $10 day or $3,000 a year. This is not intended to express net earnings but simply the average gross earnings for the press on commercial work, and we assume that it is running on such work continuously. It will be seen that delays caused by an accident to a press may prove much more expensive to the manufacturer than the actual cost of the repairs to the press itself, as a delay of a week means a loss of ten dollars a day or sixty dollars, and serious accidents often mean a month of working days or two hundred and sixty dollars, aside from the cost of repairs, which experience has shown are not to be lightly considered.

Nor is it to be forgotten that the press, to which an accident usually occurs, is generally running on a piece of work which must be completed within a given time. This means that we must lift the form and place it upon another press which has to be "made ready," perhaps interfering with other work, and all this additional cost must be borne by the manufacturer without any return for the same. Is not the manufacturer fully justified, then, in demanding that his machinery and output be equally considered with that of the electrical apparatus in the matter of protection? If the protection of apparatus worth $300.00 is deemed so important as to occupy, as it undoubtedly does, the attention of the foremost electrical engineers, are we not justified in taking the position that protective devices should be so constructed as to fully protect the manufacturer at all points, and not stop with the electrical equipment alone?

By the use of the highest grade circuit breaker now offered to the public, which fulfils in a very satisfactory manner all the requirements thus far considered, such a saving may be made, not only to the motor but to the machine which it drives, that the loss occasioned by stoppages and on account of repairs will be practically eliminated, and the device will pay for itself many times in the first year.

The delays incident to the blowing and replacement of fuses are perhaps more annoying in newspaper and publishing offices (where mails have to be met and where the time for the completion of a particular piece of work is limited), than in most classes of manufacturing, but in any case the saving is so important as to amount to very much more than the cost of adequate apparatus. Indeed, it would seem to be the best paying insurance which the manufacturer could possibly obtain. Such delays as we have been considering are practically unknown when the fuse is replaced by a thoroughly mechanically and electrically constructed circuit breaker.

With the more universal adoption of the individual motor in electrical power transmission, comes also the question of protection to operatives employed in handling the machinery. This is of so much importance that most of the States in this country have appointed inspectors to visit all manufacturing establishments and see that the proper precautions are used, and every means employed to lessen the danger to the employees, of whatever nature it may be. With all the precaution taken to prevent accidents, it is impossible to do away with them entirely. Strange as it may seem, the carelessness or fool-hardiness of the employees themselves are mainly responsible for most of the accidents which occur to-day, thanks to the hearty co-operation of inspectors and employers in their endeavors to make accidents practically impossible. Yet I know of nothing to prevent a man from placing his hands in close proximity to running gears, and if he happens to have a piece of waste in his hands and the same gets caught, the resulting damage is only limited by the quickness with which the machine can be stopped. Several such cases have come under my personal observation and only the prompt opening of the circuit breaker prevented very serious results. In one case a man's fingers were pulled into a train of gears, he endeavoring to clean the press while in motion. His fingers were badly jammed, but the opening of the circuit breaker stopped the press before any serious damage was done, and thus saved the man three fingers. Another case was that of a man who got his arm caught between the two cylinders of a press. He was fixing the packing on one of the cylinders and motioned to the feeder to reverse the press. Instead, he started it ahead suddenly, with the result that his arm was drawn in between the revolving cylinders, and again owing to the instantaneous opening of the circuit breaker the pressman escaped with a severely bruised arm, instead of crushed bones as we had all expected.

These serve as examples upon which to base a requirement that protection to operatives is not a matter of minor importance and should not be put aside with the remark, "Let the employees keep their hands out of the machinery—we cannot protect everything and everybody." To be sure, we have no electrical or mechanical device which will make brains for the ignorant or prevent careless operatives from getting hurt, yet devices can be made, as we have seen, which reduce the results of such carelessness to a minimum, and their employment should become more general as the successful operation of them becomes better known.

Having thus considered in detail the protection demanded by a large manufacturing plant using individual motors as the method of power supply, we are confronted with the proposition—can these demands be met to the satisfaction of all concerned—to the builder of machinery, as well as of electrical apparatus, and to the manufacturer using them? If such is

the case, what is the device necessary to fulfil the requirements, and is it commercially obtainable?

With reference to the fuse, we have only to read any of the scores of valuable papers written upon their action to fully justify us in writing against it "not satisfactory" and passing on. As the current itself may be the means of protection, as well as that of propulsion, the method of opening the circuit electrically should be employed. This has been successfully accomplished in the modern circuit breakers which operate on the inverse time element rather than the constant time limit.

The ultimate requirements of a circuit breaker are that we can rely upon it to do all that we have shown it should do, and operate successfully, not once, twice, or for a month, but always. When this ceases to be the case, the magnetic circuit breaker will be superseded by some other means of protection.

To produce such an instrument, the highest skill, electrical and mechanical, is required. Long study of the existing state of the art and the conditions under which circuit breakers operate is necessary, and the closest attention must be given to every detail of manufacture.

With this an accomplished fact, such results are not the only reward, however, nor should they be. The public will cheerfully pay, not only for the labor and material used in its production, but also a profit sufficient to encourage the maker and enable him to continue the work, for the perfect is never obtainable and is only reached approximately. In electrical science, perhaps more than in any other, we are never able to write the word "Finis."

Public Control, Ownership or Operation of Municipal Franchises?—IV.

With Special References to Electric Lighting.*

By R. R. BOWKER,

(Vice-President and General Manager New York Edison Co.)

OTHER ENGLISH CITIES.

OUTSIDE of London there are recorded eighteen private electric light companies and thirty municipal plants, the trend being evidently toward municipalization. The largest systems are those of Manchester, a municipal plant which last year produced 1,748,000 units at an average price of 5.25 pence and an average cost of 3.01, or fifty-seven per cent. of receipts; Liverpool, a private company, with 1,185,000 output, average price of 7.3 pence and average cost of 3.49 pence, or forty-seven per cent., and Glasgow, a municipal plant, with 1,090,000 output, at an average price of 5.58 pence and cost of 4.12 pence, or seventy-three per cent. Birmingham, noted for its municipalization of industries, decided to permit the new industry of electricity supply to go into the hands of a private company for the parliamentary period of fifty years. Of the private companies one, and of the corporations eight show greater expenditures than receipts, these being mostly small systems, only one having more than £3,000 income. At Blackburn, a municipal plant, the average price is 5.91 pence and the expenditures 10.1 pence, or 171 per cent., so that the taxpayers pay 4.10 pence on every unit sold to consumers. At Dover, a private company, the average price is 4.75 pence and the cost 8.80 pence, or 185 per cent., so that the shareholders pay 3.05 pence toward each unit sold to consumers. The highest price charged by a private company is 7.76 pence; the highest price charged by a municipal system is 6.50 pence; the highest costs are 10.1 pence at Blackburn, and 8.8 pence at Dover, an excess of cost of 1.3 pence on the municipal plant. The lowest cost is 2.72 pence in the Yorkshire private company and 2.66 in the Whitehaven municipal plant, a difference of .06 pence—practically the same. Comparisons even here are not accurate, because, though the Board of Trade returns are on closely parallel lines, they are not entirely the same, and the variants of locality cannot be considered. The closest comparison possible, perhaps, in the world, is between Manchester and Liverpool; the Manchester municipal plant, though installed so late as 1893, is of an old and almost obsolete type; the Manchester output is fifty per cent. greater than Liverpool and the cost is correspondingly lower. The figures show practically a "drawn game" as between private companies and municipal plants in England.

England has had rival telephone systems, that of the National Telephone Company and that of the government. Competition has been keen. The government system has held but 1,000 out of over 100,000 subscribers. Almost all the government exchanges have been abandoned, and the most important one existing, that at Newcastle-on-Tyne, has but one-third the number of subscribers of the private company. The government postal service was so much affected by the telephone system that Parliament passed a bill authorizing the Post Office to take over the trunk or long-distance lines, so that these lines are now maintained and operated under the direction of the postal authorities, and subscribers between the exchanges of the private telephone system are connected through the government postal lines. It may be mentioned that in Stockholm, where there is like competition between a government and a private system, the private system is also getting the lead.

NEW YORK.

New York owns most of its water front; its gross dock rentals, amounting in 1895 to $2,084,382, are paid into the sinking fund, but the expenses of the Dock Department, $1,061,697 in 1895, and the interest on dock bonds for $27,053,000, practically offset these. The city, indeed, seems to get less from its docks than if they were private property paying taxes. New York leases ferry privileges each ten years, at public sale, to the highest bidder, who must take over the operating plant at appraisement value—an excellent plan, bringing the city $346,598 rental in 1896.

New York owns and operates its water supply as well as its sewerage system. The water "rates" and meter returns at ten cents per hundred cubic feet, $3,852,396 in 1895, are paid in gross into the sinking fund, but the expenses on water account, $1,808,264, in 1895, reduce the net revenue to about $2,000,000, which is nearly offset by the interest on outstanding water bonds of $44,126,300. Interest on its full cost not accurately known but estimated at $78,000,000 would show a loss.

New York (Manhattan Island only) has four gas companies, the Consolidated including six former companies, the Equitable including the new East River Company, the Mutual with a provision in its charter against consolidation, and the Standard. It is expected that one new company will practically, if not in form, consolidate most of these interests. There have been a number of gas mains in one street. The gas companies publish no statistics of output. The price, as high as $2.25 per 1,000 cubic feet a few years ago, has been reduced by operating improvements, by competition and by legislation to $1.20 per thousand feet, the law of 1896 reducing it 5 cents per year from $1.25 till it reaches in 1901 $1.00. Oil chiefly is used for fuel. When the Edison Company began incandescent electric lighting in 1882, gas stocks dropped nearly one-half, but despite all electrical developments, the gas product has increased year by year. The four companies have a stock capital exceeding $53,000,000 and bonded debt above $6,000,000, chiefly at five per cent. The stocks show a market value ranging from $128 to $335, or an excess of $30,000,000 above par, reducing the dividend of 4 to 12 per cent. to about 4 per cent. on market value.

New York (Manhattan Island only) has seven electric central station systems with fifteen generating stations and 400 to 500 isolated plants, aggregating probably 660,000 incandescent lamps, 14,500 arc lamps (of which 2,815 are city street lamps), besides 28,500 h. p. in motors, making an equivalent of over 800,000 sixteen candle power incandescent lamps, or with motors, over 1,200,000 equivalent. There are as many as five competing conductors on the same thoroughfare. The Edison Company controls the Manhattan and Harlem high tension systems, and the United (Westinghouse) Company the Brush arc-light system, showing the trend toward consolidation.

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the buisness cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

Only the Edison Company prints a report. It has a stock capital of $8,000,000, paying originally four per cent. and now six per cent., the market price of $125 making this five per cent. on actual investment cost, and $6,500,000 in bonds, paying five per cent. interest. It had (November 30) 7,422 customers, 345,280 incandescent lamps, 4,317 arc lamps and 18,874 h. p. in motors, the equivalent of 673,484 sixteen candle power lamps, making it the largest electricity supply company in the world. Its returns in 1895 were $1,771,229, or including the high tension system, $2,222,737. The base-rate for incandescent electric lighting is one cent per sixteen candle power lamp hour (twenty cents per unit), ten cents per arc lamp hour and 10 cents per horse power hour, but all these rates are reduced by discounts and a wholesale base-rate of ten cents per kilowatt hour is made for general use. The average Edison return in November, 1897, was 8-10 cents per 16 candle power lamp hour for incandescent lighting with or 3-4 cents without lamps, or 11½ cents per unit for all services. New York City pays forty cents per night for standard arc lights, or $146 per year, being practically four cents per arc lamp hour, forty-five cents for like lamps in parks, etc., and fifty cents per pair for the Fifth avenue smaller lights. This price is reckoned to cover little above actual cost, including subway rental, of city lighting to the companies, which get their profit from commercial lighting in the same streets. Small anthracite coal costs in New York about $2.75 to $3 per ton, or "alongside" dock, about $2.25 to $2.50. No electric lighting company other than the Edison has paid dividends, except the Brush Company in its earliest years, when the price of city lighting was much higher, and the total share and loan capital of all companies averages much below par.

After Edison in 1882 had proved that electric lighting by underground conductors was feasible, a law was passed requiring all electric wires to be placed in subway ducts. Two subway companies now exist, one for high and one for low tension conductors, charging a rental prescribed by the Board of Electrical Control, a municipal commission, varying with size of duct; the rental for standard three-inch duct is $1,000 per mile, which when street lighting only is furnished is $50 per year per lamp at the usual distance of 250 feet apart. The Board of Electrical Control reported in 1896, 707 miles of ducts for high tension conductors, 211 for Edison low tension conductors, 950 for telephone and telegraph conductors and 56 of ventilating pipe. The city has had the right since January 1, 1897, to take over these ducts, subject to liens and leases, at cost and 10 per cent. per year profit (less dividends actually paid), and free ducts must be furnished for the police, fire and other city departments. House connections must be made at the expense of the supply companies, but all ducts built by or for these companies are in the legal ownership of the subway company. Besides this subway system, New York has in its subsoil a steam-heating system and a pneumatic system for the telegraph companies, producing a complexity probably beyond parallel elsewhere. It has also an oil pipe line across the city. New York receives nothing directly for its subsoil privileges except a ridiculous sum, $141 in 1895, from one gas company, and a franchise fee, $2,587 in 1895, for the oil pipe line; but the supply companies, besides paying taxes to city and State, pay also the expenses of the State commissions and boards of control.

The New York street railway system has been in process of consolidation for some years until now there remain chiefly two great operating companies, the Metropolitan and the Third Avenue Company. These are both private corporations, each transferring on its own system within the single fare of five cents. The four lines of elevated railway, originally built by two competing companies, are now consolidated into the Manhattan Company. The city has no specific rights of control over these roads, but receives certain license payments per car and other franchise payments from railroads, amounting in 1895 to $352,288.

The new charter for Greater New York makes the rights of the city in its water front, streets, etc., inalienable, and prohibits new franchises for a longer period than 25 years, with renewals optional on the part of the city aggregating 25 years more. On the termination of a grant, the plant shall become the city's property either without payment or at valuation, as the grant may prescribe; if the city takes over property without compensation, it may operate the plant or make a new lease, but if compensation be required, the city shall itself operate for at least five years—an unusual and extraordinary provision. Every grant shall provide for efficient service at reasonable rates. The jurisdiction over gas, electricity and like industries passes to the Commissioner of Public Buildings, Lighting and Supplies; and he is required to provide for tests of gas, of meters and of electric wiring. Private consumers may require a test of meters by the official inspector, the consumer paying for the test if the meter is accurate and the company if it is not.

The Proposed Holyoke Municipal Plant.

The city of Holyoke, Mass., voted on December 14 to go into municipal lighting, and the Holyoke Water Power Company has voted to sell to the city both its electric and its gas plants. It has filed a schedule of plants and price under date of January 8 with the city clerk, according to the Massachusetts law, asking $1,000,000 for the entire outfit.

The Jersey City Water Supply.

The water supply of Jersey City, under political management, instead of showing an annual profit, as it would under private management, shows an annual deficit. The water is supplied at a central point by a private company. The distribution is through public mains, yet the administration of the Water Department costs more than the water. Similar results would be shown by each of the common services required by a city under existing conditions. If the city owned the gas, electric light and power and telephone plants, each of these would produce another deficit, and the service would decline in quantity and quality.—Jersey City, N. J., Journal.

MUNICIPAL OWNERSHIP is to be debated at the Educational Alliance Hall, New York City, on February 16, by Mr. E. M. Grout, in favor, and Mr. A. R. Foote, against.

MISCELLANEOUS

A Proposed New Method of Charging a Sphere Electrostatically.

BY GEORGE H. MORSE.

THE introduction of a proof plane into an electrified sphere for the purpose of showing that no electricity can be withdrawn from the latter in this manner, is a common experiment. Even if the plane be itself electrified before being introduced, it will come out entirely neutral, all of the electricity having passed to the outside surface of the sphere. In these experiments the proof plane is, of course, understood to have touched the inner surface of the sphere for at least an instant.

Now is it not easy to conceive that an unlimited quantity of electricity at any potential may be thus carried within and imparted to the sphere by repeated introductions of the electrified proof plane? Of course, the mechanical force required to push the charged proof plane into the sphere would increase, as also the potential of the latter, with the quantity of electricity imparted to it.

In place of so laborious a method as the above we might employ a rubber or silk belt running over two pulleys, one within and one without the insulated sphere. A quantity of electricity could then be imparted to the side of the belt approaching the sphere from some constant source by means of metallic brushes. This electricity would then be carried into the sphere upon the belt where it would be collected and distributed to the former through the pulley wheel and its shaft, which should work in metallic bearings within the walls of the sphere.

Another, and perhaps a more practical, arrangement would be, to allow the outside edge of a revolving glass or rubber disc to enter the sphere and act as a carrier, the electricity being collected by brushes in contact with the inner surface. In

this arrangement, rubbers acting directly upon the disc could produce the electricity as in a frictional machine.

The writer confidently believes that unusually high potentials may be attained by apparatus arranged according to the above principle.

The Eiffel Tower Struck by Lightning.

AT a recent meeting of the International Society of Electricians at Paris a photograph was shown of a flash of lightning as it struck the top of the Eiffel Tower. This photograph was taken by M. G. Loppé. The increased thickness of the flash is probably due to the fact that at the time of its occurrence

A REMARKABLE LIGHTNING STROKE, EIFFEL TOWER, PARIS.

rain was falling in torrents. At the right of the scene are shown the arc lamps in the yards of the Western Railway, along the Seine, the image of which is also enlarged, due to the same cause.

Electricity for Balky Horses.

Electricity has more than once been suggested as an agent for conquering a balky and lazy horse. In one case recently a very high-spirited and valuable animal, but extremely vicious and balky, was cured in one hour with the aid of a three-volt dry battery. The officials of the Western Pennsylvania Humane Society were notified some time ago that Thomas Rodgers, of Avalon, was using the dry battery on his horse, which was as bad as a valuable, high-bred horse could be. Superintendent T. M. Porter investigated the case, and he gave Rodgers a hearing before Justice William Griscom, of Avalon. Rodgers said his horse was worth $1,000 if he could be cured of balking and one or two other vicious habits. He had offered $500 to anyone who could manage the animal, and at last consulted Dr. T. C. McNeil, city veterinary. The doctor advised Rodgers to try electricity, and he bought a three-volt storage battery, and by means of three wires connected each side of the bit and crupper with the battery. The horse was hitched to a road cart and at first refused to move, standing with all four feet in a braced position. Rodgers then had the wires connected to the battery, which was placed in the cart, and at the first push of the button the horse jumped, snorted and then moved off. Each day for a week he went through the same lesson. This was the testimony brought out at the hearing, and as the veterinary and squire thought three volts was not sufficient shock to hurt the animal, Rodgers was discharged.

TELEPHONY AND TELEGRAPHY

Telephonic Train Dispatching.

The new Michigan State Telephone Company has contracted with the Detroit and River St. Clair Electric Railway Company for the construction of a train dispatching telephone system extending from Mt. Clemens to Marine City along the route of the road, touching Chesterfield, New Baltimore, Fair Haven and Algonac. Branch lines will be built to Pearl Beach, Miller's and Starrville. The system will be used also as a toll line, having connection with the central office at Mt. Clemens. Work will be commenced at once, and the entire system will be in operation February 15.

Cheap Telephone Rates in Berlin.

Reason why Germany wants to gobble up China is shown in the following dispatch of January 1: "The annual charge of $37.50 for telephone service will in future be replaced by a yearly rent of $12.50 for the apparatus plus the small charge of 1 pfennig (about one-fourth of a cent) for each conversation by private persons, 2 pfennigs for business men and firms, and 3 for clubs and cafés, etc. Business men are strenuously opposed to the proposal that they be charged more than any others."

Control of Telegraph Cables.

At the request of the Secretary of State, Acting Attorney-General Richards has given an opinion on the question of the authority of the President, in the absence of legislation in the matter, to control the landing of foreign telegraphic cables. The question was raised by the action of the French Cable Company, in landing a cable at Cape Cod without the express permission of Congress or the President. Mr. Richards' conclusions are as follows:

"The President has the power, in the absence of legislative enactment, to control the landing of foreign submarine cables. He may either prevent the landing, if the rights intrusted to his care so demand, or permit it on conditions which will protect the interests of this government and its citizens; and if a landing has been effected without the consent or against the protest of this government, respect for its rights and compliance with its terms may be enforced by applying the prohibition to the operation of the line, unless the necessary conditions are accepted and observed."

"Independent" Telephone Companies and the Berliner Microphone Patent.

WE give below full text of a letter issued under date of January 1, 1898, by the Independent Telephone Association of America, signed by Mr. H. D. Critchfield, and dated from Mt. Vernon, O.:

You are urged to carefully read the following letter, which is upon a subject of personal interest to you and all others similarly situated.

You are undoubtedly aware that the American Bell Telephone Company has brought two suits on the Berliner patent and has been and is threatening to bring many others against owners and operators of independent exchanges. The Bell people, of course, claim that the Berliner patent covers all forms of microphone transmitters used in connection with a battery circuit. The two suits above referred to are pending in the United States District Court for the Northern District of Massachusetts at Boston. One of these is against the National Telephone Company and the other is against the Century Telephone Company. These suits were brought in August, 1895, and have been pending since, but were not vigorously pushed until recently, when the suit involving the issuing of the Berliner patent was decided by the Supreme Court of the United States in favor of the American Bell Company. Since

the handing down of the decision in this case the Bell people are pressing the Boston suits before referred to.

The American Bell Telephone Company, as all must admit, is a thoroughly organized and powerful corporation, and it is only fair to assume that they have been preparing for this day (the time when their right to a monopoly of the telephone business would be questioned) ever since their organization in the '70's, and that their aim has been to get in such shape as that when opposition sprang up they would be in the best condition to combat and crush it out of existence if possible. If they should be successful in the litigation now pending, to say nothing of the numerous other suits they are threatening to bring, it seems, from the best information we can obtain, to be their purpose to make application simultaneously in all the other Federal District Courts to restrain the manufacture or use of the microphone transmitter and to procure temporary injunctions against operators of independent exchanges, which, of course, they will seek to have made perpetual upon final hearing. It is needless to suggest that the granting of even temporary injunctions and the closing up of independent exchanges would be fatal to the independent telephone interests, even though it were possible in a few months to procure the dissolution of such injunctions.

The Independent Telephone Association of the United States was organized for the mutual benefit and bringing together of all independent telephone interests in the United States. There are many things which this Association contemplates, but the immediate and pressing call for action is with reference to the patent situation. The organization, through its officers and advisory board, has been and is now, taking most comprehensive and vigorous action and making thorough preparation to prevent further litigation so far as possible and to take care of it when it comes. To this end there has been retained as able counsel, skilled in telephone and patent law, as the country affords, and practical and theoretical telephone experts, with a thorough knowledge of telephony, who are now engaged in making experiments and gathering data, both in this and foreign countries, with the intention, and for the purpose, of being ready at a moment's notice to take up the defense of suits which may be brought against any member of the Association on the Berliner patent, at any point in the United States, and to throughly and vigorously defend the same without cost to the member, except its proportionate assessment as contemplated in the constitution, not only to do this, but to prevent, if possible, the bringing of such suits and the granting of preliminary injunctions.

The work which the Association has undertaken, and is now prosecuting, has and will require a large amount of money. It is a question of meeting a powerful enemy with its own weapons, and this can only be done by joining our forces, raising the necessary funds to prepare for and fight such cases; it is simply a matter of uniting to do that which individual companies are wholly unable to do. You can readily see that no single exchange, or no small number of them, will be able to meet such a large expense. It is confidently believed that if the objects of this Association can be carried out that the Berliner patent will fail, but if such steps are not taken, and all possible defenses set up in any suits which may hereafter be brought against members of the Association, and sustained by proof, the danger from the Berliner patent is great and imminent. Of this there can be no doubt.

Satisfactory progress has thus far been made in the organization of the Association, and it is an accomplished fact, but its power for good and its ability to protect its members depends upon its strength, numerically and financially, and all independent organizations are vitally interested in its success. When the patent situation is cared for, vast sums of capital will seek investment in this field, both in exchange work and long-distance lines, and the accomplishment of the latter is greatly to be desired. You undoubtedly see daily the benefits that would come to you from having first-class long-distance connection with all the other independent exchanges in the country, and especially to have exchanges in large cities and connection therewith. But the first thing to do is to protect ourselves against the common enemy and its patent claims. This can only be done by organization, and any delay in this work is extremely hazardous.

Again let it be said that the whole thing seems to depend upon the care taken and thoroughness in preparation for defense. It is confidently believed that the Berliner patent has long since expired, but that a systematic and thorough effort has been made by the Bell Company to prolong its existence, and if all is not done that can be done to defeat their claims, they will continue to enjoy the monopoly of the telephone business in the future, as they have in the past; the money invested in the independent movement will be lost, and competition wiped out of existence.

A similar letter has this day been sent to each of the directors of your company, and to the manager of your exchange, with the hope that you will take this matter up at once and become a member of this association, and contribute your share to the common defense. A copy of the constitution is herewith inclosed. You will see that the management of the affairs of the association is vested in the officers, advisory board and executive committee; that the members of the excutive committee are selected from each State; that this committee in turn selects the advisory board; that the advisory board is responsible to the executive committee, thus bringing the management in close touch with the individual members of the organization. The constitution also provides that the advisory board may levy an assessment not to exceed 50 cents per telephone, and 50 cents per mile for pole lines carrying toll wires, in any one year. This is the maximum amount for which you could be called upon under any circumstances; but since the adoption of this constitution unexpected assistance has enabled the advisory board to limit the assessment to 20 cents per telephone, and 20 cents per mile of pole line, and no further assessment will be made during the current year. It is believed that this will accumulate a sufficient fund to take care of all expenditures required for that period, and, as the bulk of the expense comes the first year, it is believed that a small assessment, not exceeding 3 to 5 cents per telephone and mile of pole line, together with the membership fee and assessment to be paid by the companies hereafter joining the association, will be sufficient to maintain the organization in the future. This, you understand, means that any company becoming a member of the association, whether now or hereafter organized, must pay its full proportion upon entering, namely: ten dollars ($10) membership fee, and 20 cents per telephone, and 20 cents per mile of toll line, it being the purpose and positive intention to treat everybody exactly alike, and not to allow such as may come in at the eleventh hour to reap any benefit for which they do not pay their full share. The State organization will not be disbanded, but as the national organization takes its place, covers a much broader field, and constitutes a much more powerful organization, no assessment will be made on account of the State organization hereafter.

An application for membership has been inclosed to the manager of your exchange. The membership fee and assessment must accompany this application, and check or draft for the amount made payable to W. J. Vesey, secretary, Fort Wayne, Ind., and forwarded to me at Mount Vernon, Ohio, upon receipt of which the secretary will forward you an official receipt for same.

Important steps are contemplated by the association, and must be taken in the near future. For this reason you are urged to give this matter your prompt attention, that the organization may know that it will have the funds necessary to carry out its plans, and that it is safe to incur the necessary expense therefor. The work of organization is being carried on in other States prominently identified with the independent movement.

Telephonic Wire Tapping in Ohio.

The Central Union Telephone Company, at Columbus, O., has promptly taken up the bribery charge in connection with Hanna's election in order to protect its patrons. This action may make it difficult to secure evidence as to the alleged telephone wire-tapping by which it is said the bribery scheme was discovered. A new law in Ohio makes it a penitentiary offense to tap a telephone wire, and the telephone company will prosecute any one who admits that he was a party to such tapping.

THE WESTERN UNION TELEGRAPH CO. is reported in the daily papers to have some kind of claim against Spain for losses inflicted on its Key West cable business by the censorship at Havana. Vice-President T. F. Clarke is alleged to have made representations to our own Government on the subject.

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Central Station Work Here and in England.

THE last number to hand of London "Lightning," January 13, has a very interesting account of a dinner given by a representative gathering of English electrical people to President S. Insull, of the National and Edison Associations. That gentleman, by the way, has just returned home to Chicago, but he found in the British metropolis a very keen desire for information as to our central station work in America, and was in no wise slow to impart it, which few could do as well as he. This dinner was a felicitous illustration of the entente cordiale existing between English and American electrical folk, for while Mr. Insull, as an Englishman born, represented one of the most progressive local American companies, there were at the table such men as Mr. Robert Blackwell and Mr. Parshall, who may be said to represent our manufacturing and engineering sides. Mr. Parshall, a graduate from the great Schenectady shops which Mr. Insull himself created for Mr. Edison, stands high in English estimation, just as we here appreciate in Mr. Insull the virile qualities that have carried him to so high a position in the electric light and power industry of America.

One can read between the lines of the report in our English contemporary. There was evidently much said in confidence around the social board that was not put into type, but the broad lines of the discussion stand out, for as usual, they got to "talking shop," and mighty good talk it must have been, with Messrs. Crompton, Ferranti, Garcke and Wright in the symposium. In a city of scattered numerous stations and no power loads, Mr. Insull preached the pure and simple gospel of big unified generating plants and all the power you can clap on to the circuits. He did not hesitate to give Mr. Ferranti the credit for part of this absolutely unimpeachable programme of advance. He assured them that it would be difficult to find anywhere a city in which electricity for purely lighting purposes was in such universal use as at Brighton. Possibly that was the result of a certain method of charging developed by Mr. Wright. There seemed to be right and reason in it, and he was inclined to try something of the sort as soon as he got back to Chicago. Some of their load in America might be due to the fact that the Edison Illuminating Companies had realized from the first that the all-day use of electric power would ultimately form an important factor in lowering the average cost of current generated by electric supply companies. That was the reason why the Edison companies in America had adopted the policy, as far back as the early eighties, of selling current for power purposes at about half the price charged for lighting purposes. In England, and in London he thought particularly, there seemed a magnificent field for motors, which, when it was taken up, might make some of their American figures look small. The way was to get large consumption by a favorable tariff, and to keep down the charges for interest and works costs by having modern plant and concentrating it in few stations. It could not be expected that a satisfactory load factor could be obtained unless the basis on which the current was sold was one which would encourage long-time consumption. High peaks and high cost of current were the direct result of a prohibitive selling price.

Mr. Insull practices what he preaches, in Chicago, and the latest example, that of Brooklyn, just shown in these pages, with 70 square miles of supply area, all in the network of one big plant generating at high pressure transmission for low pressure distribution, demonstrates how quickly our central station leaders are marking out the new path of progress and entering the new era of universal use of electric current.

Ho! For the Klondike.

ANOTHER great gold rush is impending this spring, and before long thousands of eager gold seekers will be pouring into the Klondike by every avenue of access. There is every reason to believe that the output of the precious metal will be extraordinarily large, so that the perils of the long trip and the inhospitality of the Arctic region will be compensated for by the richness of the reward. It is curious to note how the endless quest for gold shifts now from Central Africa to the icebound recesses of the Yukon, for both of which regions man had apparently little use. But you can never tell where treasure is going to crop up. Once in a while, a far-sighted prophecy is made. Before the discovery of the famous Comstock Lode in Nevada, the late Horace Greeley said: "I believe the Almighty has created nothing in vain, and as I have passed over this awful region, the thought has fixed itself in my mind, that, since it is certainly useless for every other purpose, it may be a land of vast mineral wealth. If that be so, it will take a hundred thousand Californian miners a hundred thousand years even to prospect it." In view of the fact that there are a hundred thousand square miles of auriferous territory in Alaska awaiting the miner's toil, we will surmise with Greeley that Providence had a reasonable object when it thus put the mother lodes in that land of wellnigh eternal ice and snow.

Electrical engineers are deeply interested in the invasion of the new gold territory. This week we illustrate the shipment of electrical apparatus by means of which travel over the dread Chilkoot Pass is to be made safer and cheaper. Meantime, telegraph and telephone lines are penetrating the region, and various plans for electric light and power enterprises are afoot; while one scheme even contemplates the use of steady electric heat for thawing out the icy mass of mud, rock and sand in which the gold lies buried. Why not, and many other uses of electricity which shall tend to reconcile the miner to his exile and make a hard life more pleasant in the desolate Klondike?

How Some City Statistics Are Manufactured.

DISQUIETING reports reach us from the far State of Washington as to some of the evidence brought forward at Tacoma in the trial of City Electrician Joslyn, before the local civil service commission, for incompetency. There is a good deal of mystery around the whole business, and we will not undertake to clear it, for we are quite ready to believe that things are all right and that there are no politics in municipal affairs in that bustling city, way off Northwest. We trust that Mr. Joslyn may be able to clear himself of the charge that he falsified his figures in order to make out that the city would produce current cheaper than the Tacoma Railways Company. Councilman Holgate testifies that Mr. Joslyn intimated to him that the reports were made out at the instance of the municipal administration so as to discriminate against the private company. "Joslyn had told him that the figures were not correct; that many items of expense had not been

charged which should have appeared on the sheets and that if all had been charged the cost per kilowatt would have been increased to more than two cents per hour, while the report showed that each kilowatt hour had cost during the last month only 1.77 cents." As we said above, everything may be all right, but it is little incidents like this that check one's ready confidence in the accuracy of the statements as to the economy of municipal plants.

A New Trouble for the Consulting Engineer.

THE recent agitation in the United States on the part of manufacturers to relieve themselves from the burdens frequently put upon them by the consulting engineer finds a pathetic counterpart in a case recently brought to light in England; but with this difference, that in the latter case it was the consulting engineer who deemed himself the aggrieved party. It seems that a district council called upon a well-known firm of consulting engineers to advise them in a certain matter, and then submitted the identical question to another consulting engineer without informing either of them that the other had also been consulted. Of course, as soon as the fact leaked out, the firm first mentioned above resigned its engagement. The question involved in this instance is one between client and technical adviser, and in this particular case it was evident that the latter had some rights which the client was bound to respect, just as the manufacturer has some rights which the consulting engineer ought not to lose sight of. It is one thing to employ a consulting engineer to draw up a general plan and to call upon bidders to submit their own details with estimates, from which the consulting engineer can select the plan best adapted and for the least cost; but it is quite another matter to impugn either the ability or the honesty of a consulting engineer by submitting the same work to another without due notification to that effect. Such cases are not likely to arise very often in practice, but their casual occurrence serves to show the necessity for some code which ought to be so well known that such embarrassing situations would not occur. Now that the American Institute of Electrical Engineers is about to take up the standardizing of electrical apparatus, why not go a step further and lay down a code which will become an official guide as to the relation between purchaser, engineer and manufacturer? An efficient code of this nature would be helpful to all parties concerned. If, in addition, it embodied regulations as to fees, etc., it would be doubly acceptable to the engineer. A code of this nature adopted by the American Institute of Architects has been found to work very well. In the latter body, infractions of the code, if proved, may be followed by expulsion from the organization. It must be evident that the American Institute of Electrical Engineers has a good deal of work still ahead of it, and we expect it will take care of all of it in due season.

An Imperial Electrical Inventor.

THE career of American electric street railway apparatus in Germany may be destined to be a short and merry one, for the news has come very circumstantially of late that the Emperor himself proposes to invent a new electrical car for Berlin, and, if for Berlin, then for all Germany. A few years back, Prince Henry, the Emperor's brother, repeated all the sensational Tesla experiments with currents of high voltage and high frequency, and not many months ago we noted the fact in these columns that the Emperor, the Prince and some high army officers were taking a special electrical course. This all goes to confirm the rumor. We are sure his majesty can help the electric railway art materially, for it has been said that he has a rolling eye of genius just like Edison's; although we have never seen Mr. Edison roll his eye, unless a wink is included in the expression. But what worries us is that we don't see where the Emperor is to get the time; he is so busy. There is Turkey to be patronized; Greece to be snubbed; Russia to be flattered; France to be flouted; England to be insulted, and China to be cut up, all of which he is giving personal attention to, conscientiously. But his majesty is also otherwise engaged, in oratory, music, art, the drama, yachting and a few other diversions. Now the success of such railway inventors as Sprague and Short has come from pretty close attention to one thing. It is true that Tesla dines at Delmonico's; that Edward Weston delights in his big naphtha launch, his camera or his telescope; that Elihu Thomson and Steinmetz persist in scorching on their beloved bicycles; but, after all, their one serious thought and aim in life is electrical investigation and invention. We are sorry that so far as the Emperor's character has interpreted itself to us, his great genius lacks concentration. This is electricity's loss, but we may all just as well make up our minds to stand it. If there is one constant element in the case, it is the Emperor's inconstancy; and he will soon be forgetting that electric car for a balloon, a gun, a picture or a navy.

Double Decked Cities.

ONE of the plans most in favor lately in regard to the renovation of the New York Elevated and its operation by electricity, has been that of double decking the road. The New York "Herald" has also come out with an illustrated plan for double decking the whole line of the proposed viaduct across the valley at West 125th street, continuing the Riverside Drive northward. There is nothing amiss with such schemes, and such an arrangement of city traffic is certainly more likely and feasible than boring underground in the dark bowels of the earth, seventy or eighty feet from the surface. But we wish to recall the fact that just such a plan, only fuller, with much circumstantial detail, was laid before the old Electric Club of this city in 1891, by Mr. Allen R. Foote, a copy of whose admirable paper on the subject is now lying on our desk. Since that time, many conditions have arisen to confirm his views, and none of them have been more striking than the differentiation of the various means of traffic and locomotion in our streets. Such traffic now is badly in need of sorting out on many main lines of thoroughfare, and the introduction of asphalted streets, electric carriages and bicycles will go on with faster pace than ever when Mr. Foote's ideas are realized of a double-decked city street.

Things That Were Not What They Seemed.

LAST week, in spite of our rule against involving this journal in disputes with other papers, on subjects of a non-technical nature, we felt it our duty to issue a warning to our readers in regard to documents that were being circulated by another electrical publisher against his fellows in the journalistic field. One of these documents was a fac-simile letter, the other was an unsigned circular based on it. The fac-simile letter was signed by the advertising agent of an electrical company, whose president, on investigation, has repudiated it. The unsigned circular purports to prove how the various electrical journals compare as advertising mediums, as shown by the "keying" method adopted by the electrical company, said keying being suggested by the aforesaid publisher, who besides being the only publisher who knew about the matter secured a keying address in the building long occupied by the company, while The Electrical Engineer, for example, was given one across the street—a liquor store. We think our readers can see where the "keying" test might come out, under all these suspicious circumstances—just where it did, although even of this no evidence of accuracy can be obtained; and we think they will also understand its swift exposure when the facts came to the light. To speak severely of such an insidious method of warfare on fellow publishers would certainly be justifiable, but we shall, as hitherto, leave our readers to arrive at their own conclusions. They probably will not have difficulty in guessing the name of the publisher who did this thing, and who, having arranged it all, asked for the advertising agent's letter in regard to it and then announced that the letter was "unsolicited."

ELECTRIC TRANSPORTATION

Rural Electric Roads in Michigan.

IT is probable that in a very few years Michigan will be as liberally gridironed with electric railroads as she is with steam lines now. Already 165 miles of rural lines have been built or are under construction, upward of 400 miles more are projected and nearly as many miles are under discussion. The electric lines already in operation or under construction are as follows:

The Rapid Railroad, from Detroit to Mount Clemens, fifteen miles.

Mount Clemens & Lakeside Traction Company, from Mount Clemens to Lakeside, two and three-quarter miles.

Detroit & River St. Clair Railroad, from Mount Clemens to Marine City, thirty-seven miles.

Detroit, Lake Shore & Mount Clemens Railroad, from Detroit to Lakeside, twenty-six miles.

Detroit & Pontiac Railway, from Detroit to Pontiac, twenty-one miles.

Pontiac & Sylvan Lake Railroad, from Pontiac to Sylvan Lake, three miles.

Detroit Suburban, from Detroit to Grosse Pointe, four and one-half miles.

Highland Park Road, Detroit to Highland Park, five miles.

Detroit, Ypsilanti & Ann Arbor, from Detroit to Ypsilanti, and thence to Ann Arbor, thirty miles.

Wyandotte & Detroit River Line, from Detroit to Ecorse, Wyandotte and Trenton, ten and one-half miles.

Ann Arbor & Ypsilanti, from Ann Arbor to Ypsilanti, over an old steam road built eight years ago, ten miles.

Owosso & Corunna Railroad, from Owosso to Corunna, three and one-half miles.

Interurban Railway, from Saginaw to Bay City, thirteen miles.

Wenona Beach Branch of the Bay City Road, three miles.

Lansing Street Railroad Company to the Agricultural College, three miles.

Grand Rapids Street Railroad, from Grand Rapids to Reed's Lake, four miles, and to the Soldiers' Home, three miles.

Manistee, Filer City & East Lake, from Manistee to suburban towns, eight miles.

Muskegon Street Railroad, from Muskegon to Lake Harbor, six miles.

Holland line, from Holland to Macatawa Park, five miles, and thence south to Saugatuck, eight miles.

All these roads have been built and are now in operation, or will be pushed to completion in the coming summer. The roads projected are more extensive and have a greater mileage than have those already in existence and several of them undoubtedly will materialize either this year or next. The projected lines are:

Detroit to Toledo, fifty miles, with two companies figuring on it and one of them claiming to have acquired most of the necessary right of way.

Bay City through Wisner, Akron and Columbiaville, to Sebewaing, thirty miles.

Lansing, through St. John's, Maple Rapids, Pompeii, to St. Louis, fifty-three miles, with ultimate extension to Midland. The company has already been incorporated.

Lansing, through Danville, Birkett's and Unadilla, to Dexter and Ann Arbor, seventy miles. This company has been incorporated.

Detroit to Romeo, thirty-three miles.

Hart, through Hesperia to White Cloud, thirty-five miles.

Detroit to Pontiac, by way of Redford and the lake resorts, thirty miles.

Pontiac to Flint, forty-two miles; right of way already secured.

Bay City, through Saginaw, Caro, Sanilac Center and Croswell to Lexington, ninety miles, with a probable extension down the lake shore to Port Huron.

Kalamazoo to Battle Creek, twenty-five miles; right of way secured and work will be begun this season.

Dundee to Monroe, seventeen miles.

Lambertsville to Toledo, eighteen miles.

Coldwater to Union City, thirteen miles; also from Coldwater to Fremont, O.

Benton Harbor east ten miles, then one branch to Allegan, sixty miles, and another to Cassopolis, forty miles. The road is partly graded, but the company has become involved in litigation.

The talked-of lines are numerous and new ones are being brought to the front almost every day. The most important of the lines that are still very much in the air are from Grand Rapids to Grand Haven, from Grand Rapids to Muskegon, from St. Louis to Midland, from Marine City to St. Clair and Port Huron, from Battle Creek to Lansing, from Lansing to Allegan and Saugatuck; from Coldwater to Bronson, Quincy and Orland, Ohio; from Sheboygan to Mullet Lake, from Standish to Au Gres, from Saginaw to Flint, from Flint to Fenton. The upper peninsula has several lines projected connecting the different towns in the mineral regions, but the plans have not been fully developed.

Long-Distance Trolley in Kansas.

The Kansas City, Lawrence and Topeka Electric Railroad and Power Company, which was granted a charter by the Secretary of State at Topeka recently, with a capital stock of $3,000,000, has been organized under this charter in Kansas City, Kan. E. B. Purcell, of Manhattan, Kan., a former director and promoter of the Santa Fé Railroad, was chosen president; John G. Johns, a wealthy stockman and railroad promoter of Houston, Tex., was elected secretary; Edward G. Anderson, an attorney of Kansas City, Kan., was made assistant secretary; and James Haggart, of Kansas City, Mo., was chosen treasurer. The directors are these four officers, Henry McGrew and W. L. Wood, of Kansas City, Kan., and T. E. Holmes and A. H. Gossett, of Kansas City, Mo. The company plans to construct and equip an electric railroad from Kansas City to Topeka, and operate it for both passenger and freight traffic. It also proposes to furnish electricity to the cities and towns along the line for manufacturing and lighting purposes. The work of securing the right of way for the railroad will begin at once.

Connecticut Trolley Interests.

The partial report of the Connecticut Railroad Commission, lately published, gives opportunity for the annexed comparison of capitalization and debt of Connecticut trolley companies in 1896 and 1897:

	1896.	1897.
Total stock issued	$9,221,740	$9,770,440
Issued for cash	2,671,240	3,106,940
Bonded debt	8,690,100	9,092,800
Floating debt	849,255	1,071,421

The figures show that while there has been a slight gain in the ratio of stock paid in for cash to stock issued, there is still more than three times as much of the latter as of the former, while the bonded and floating debt considerably exceeds the stock issued. The amount of capital stock authorized is $18,248,000.

The promoters of the projected trolley parallel between Norwich and New London claim that they have secured in Boston the funds necessary to build the line. They have submitted their layout to the authorities of the towns of Montville and Waterford, and the necessary appeal to the Superior Court of New London County on the question of public necessity and convenience will follow.

The extension of the third-rail route for ten miles, from New Britain to Bristol, will probably compel changes in the New England track, and the building of two or three new stations. The third rail will parallel an existing trolley line.

An interesting phase of steam and trolley competition is soon to be that between the New England's "composite" car and the trolley from Rockville to Hartford. The composite car, with its steam motor, will make the distance (about seventeen miles) in considerably shorter time than the new trolley, but has the disadvantage of not running through the streets of either of the terminal cities. The long trolley road recently opened has been well patronized.

LETTERS TO THE EDITOR

The Relations Between the Consulting Engineer Manufacturer and Purchaser.

THE recent discussion of the relations between the consulting engineer, manufacturer and purchaser by the New York Electrical Society was very interesting, but let me here suggest a point or two not then mentioned.

1. Let the manufacturer so build his apparatus that he will not be confined to standard machines, but let him so standardize individual parts that most any new combination of such parts can be made into nearly any special machine desired without greatly enhanced cost or embarrassment to any one concerned. In other words, greatly extend the present system of interchangeable parts so as to cover a much greater field. The subject is too large to be more than hinted at now, but there is room for such a development here as will astonish many as times and ideas advance. More intercourse between the parties named above will materially aid this matter, which is sure to increase in importance.

2. A little better training of the manufacturer's selling agents than the writer has noticed in some cases will aid all of the aims of the discussion the other evening and of this letter.

3. A much greater knowledge of shop practice on the part of consulting engineers is necessary. Want of this has led to a great deal of unnecessary work and expense on the part of all parties concerned.

Such seems to be a brief summary of the whole situation. The writer has had experience with manufacturing and consulting work from which he draws the above inferences.

New York City. JAMES H. BATES.

Exhaust Steam Heating.

IN the issue of Jan. 13, "Sic 'Em" criticises "Le Chat" for straining a point in speaking of 12 pounds back pressure on an engine for heating systems, and promptly proceeds to make a worse mistake by saying that "supplying the engine with an increased boiler pressure equal in amount to the back pressure straightens things out." Does "Sic 'Em" know that the initial pressure is constant for about one-quarter of the stroke and therefore the initial pressure must be increased about three or four times as great as the back pressure is, in order to "make the engine do the same amount of work as before?"

If "Sic 'Em's" article was true, then a condenser would have no further effect than increasing the boiler pressure by about 13 pounds, whereas we all know that increasing the boiler pressure 40 pounds would not add to the power of the engine as much as a condenser would.

The only way to heat by exhaust steam is to use a vacuum system and remove the back pressure, thereby retaining the efficiency of the engine and still benefiting by the otherwise wasted heat units. W. B. LEWIS.

Providence, R. I., Jan. 20, 1898.

No Politics in Detroit's Municipal Affairs.

My attention has been called to your editorial article, "Politics in Detroit Lighting." If there is any place in America where there is not nor ever has been any politics, it is in the Detroit electric lighting plant from its inception up to now. The only reason that made it possible for Detroit to have a lighting plant, was the poor service that it had received from the company furnishing light, and the high price charged. I was one of the original commissioners, and from the first meeting of the commissioners until now, nothing appertaining to politics has had anything to do with the plant or its management.

I am greatly in favor of intelligent and honest discussion on the question of public lighting, and although I believed, and still believe in a public lighting plant for Detroit, I am not prepared to say that every city should own its own plant; but I think those opposed to a city furnishing its own light are not adding any to their side of the argument by saying that politics was the cause of putting in Detroit's plant.

J. L. HUDSON, President.

Detroit, January 18, 1898.

SOCIETY & CLUB NOTES

President H. C. Higgins' Address Before the Northwestern Electrical Association.[1]

IN my few remarks I wish to say something about gas and electric street railways as well as electric lighting. We have in this association several members who represent both those interests, and as they are semi-public enterprises they are to my mind kindred industries to a certain extent. It is gratifying to know that we have bridged over the hard times and are now on the eve of better times. People have been economizing in gas and electric light and and in the nickels that in ordinary times have gone to the street railway.

The Edisons, Thomsons, Houstons, Brushes, Van Depoeles, Westinghouses and others have invented and sold us the excellent products of their wonderful genius, and at excellent profits to themselves, but they have neglected one very important thing, that is, directions to us, or how to operate the goods with profit to ourselves, which the hazard and annoyance, and the necessary investment would justify.

Hazardous because of the many dangerous things that can take place in connection with our plant, that would be ruinous to it, such as an opposition municipal plant or a serious accident causing many thousands of dollars, a disastrous fire, etc., and while we do not want to condemn the electric lighting business, I will say that I see before me here the faces of many men who have been in the central station electric light business for years, some of them having grown gray in it, and I do not know of more than one or two instances where they have ever realized one dollar on their many years' investment; still the public think we have too many privileges and are getting rich through the business.

To be sure, we who went into this business in its early history, have had much to contend with, that we do not come in contact with now; we have learned something about the business ourselves, and can now get more efficient help than formerly and at reduced wages; our supplies are much cheaper, and although we have all reduced our prices for light, I am sure that we are all doing better in a financial way, than we were in the early history of the business.

One dangerous element that we have to look out for is the political schemer, who is always working "for the dear people," and the gas and electric light companies are destined subjects of his attack. All our legislative halls from Congress down to our own little municipalities have quite a sufficiency of this element. He is constantly working on some scheme that will defeat the local lighting companies. You may ask me for a recipe for treating him, but I must answer that I have none other than to meet him with good work and honest facts. Give the public good service and fair prices and courteous treatment and the battle is three-fourths won.

The gas business; there is but little use of saying much for it. It will speak for itself, and like the poor, will always be with us. We, who were in the gas business, when the electric light business was first introduced, will remember well how fearful we were, lest the new light should send us out of business; but the genius has not been idle in this branch of the lighting business, for while such good improvements have been going on in the field of electric lighting, improvements in gas appliances and machinery have also been going on, and to-day gas interests and securities stand higher in the financial market of the country than was ever known before electric lighting was introduced, and as yet, neither industry has hurt, but rather helped, the other. Gas is fighting hard to retain supremacy, and I think there will always be a sufficient field for both, if the man from Logansport, hasn't something up his

[1] Abstract.

sleeve to ruin the eyes of the entire human race, in his late invention.

I wish it to be understood that my remarks on street railway matters shall apply principally to street railways of the smaller class, in towns of from ten to fifteen thousand population.

The street railway business has, I think, suffered more within the past two years than any other legitimate business. Not only have the hard times worked against them, but the bicycles have taken a large percentage of their business. The new woman and many of the old ones have hied themselves away from us on their wheels, and both have had plenty of followers. They have quit us cold, but it is to be hoped that they will soon return to us in a changed temperament, for as repair bills for broken bicycles are met with and the many various disappointments which surround wheeling have become unbearable to them such as punctured tires, breakdowns far away from home, etc., have worn out their patience, they will return to us and give up their nickels to the electric car even more willingly than they have ever done before.

It is gratifying, however, to street car men to know that the expenses of operating as well as those of original purchase have been very much reduced. The reduced receipts have had much to do with the reduction in operating expenses so that perhaps after all the reduced receipts have been a blessing in disguise, although the reduced receipts have certainly not been the whole cause of our reducing expenses, for when we first went into the electric street railway business it was all an experiment from start to finish. I might more properly say an experiment from Lynn to Schenectady, clear down the line to the rail bond. We all thought in those days that about all that was necessary was to secure a favorable franchise and the electrical companies would do the rest, but I know of no writing that so fittingly applies to the case as a verse in one of Moore's poems which reads:

I saw from the beach when the morning was shining
  A bark o'er the waters ride gracefully on,
And I saw from that beach when the eve was declining
  The bark was still there, but the waters were gone.

The nickels which we had expected to have supported our enterprise had like the waters gone and left our bark, the street railway, stranded. We certainly have done more for the public than we have for ourselves and our associates in the building up of these electric street railways in the past, though I look forward to the future of this business with considerable hope, and as I have been through the poor track and poor car business, and one of the pioneers in the street railroad park business I feel that it is not egotism to say that I am competent to give some advice to my fellow sufferers in that line. Do not use less than a 60-pound steel T-rail; use good, sound ties not less than 6 inches wide; lay them two feet centers and still closer is better; bond with not less than No. 0 bonds; use nothing less than 0 trolley wire; buy nothing larger than 16 to 20-foot cars for general use, and you cannot make much of a mistake by buying the latest type of generators and car equipments from any of the leading companies making and selling such appliances. With such a track and appliances and cars as I have described you will have a very pleasant business providing your patronage will justify the outlay.

Do not, however, lay any extra line in order to establish a park, unless you can establish it on the edge of a body of water and have a town of not less than 30,000 people to draw from. Do not lay out much money on animals for your park. The park season is short and the balance of the year in which animals must be fed and cared for is so long that except as a matter of pride it does not pay to have a zoological department to your park. People very soon tire of looking at animals. Do not run vaudeville or other shows unless you are so situated that their transportation will cost you but little. I believe that street railway parks should be well enclosed and no one admitted except they pay carfare each way, no matter whether they come by carriage or bicycle. I do not believe that any town of less than 25,000 people will support an electric street railway and give a decent return to its investors, although two towns aggregating a little less than that population and being some distance apart might be good paying properties, although local conditions would have very much to do with this. I have known of towns of this size and seemingly about the proper distance apart, and without a cent of interest to pay and light taxes, almost no insurance and lying in the heart of a good coal district, where they got their coal for almost the hauling, (and although the road appeared to be well managed), still it went into the hands of the receiver for sheer lack of patronage and is still in his hands, and the Lord only knows when it will get out of his hands.

And now in my closing remarks in relation to electric street railroading, while congratulating ourselves upon the pleasant side of the business, I would ask, how long the restless brain or the genius of the nineteenth century or even the twentieth century, coming and already on our threshold, will let us alone? How long will it be before they will have something better to offer us for transporting passengers than an electric street railway? We are already threatened with the airship and the horseless carriage. What will be accomplished in this line is mere guesswork. Let us hope, however, that at least we who are in the business to-day will get a much needed rest from any further experiments.

American Institute of Electrical Engineers.

The 121st meeting of the Institute will be held at 12 West Thirty-first street, New York City, on Wednesday, Jan. 26, at 8 o'clock p. m. At the suggestion of the executive committee the evening will be devoted to a discussion of the "Standardizing of Generators, Motors and Transformers." It is proposed to discuss the question from the technical standpoint, in its relations to the designer, the manufacturer, the consulting engineer and the user. Consideration will also be given to the policy on the part of the Institute in undertaking to bring about the result indicated in the foregoing title.

A meeting of Western members for the discussion of the same subject will be held at the Armour Institute, Chicago, on the same date and hour.

Texas Gas and Electric Light Association.

A JOINT meeting of the executive committee of the Texas Gas and Electric Light Association and Texas Street Railway Ass'n was held at Austin, Tex., Jan. 16, 1898, L. T. Fuller presiding. Those present were: L. T. Fuller, of Calvert; Carl F. Drake, of Austin; C. F. Yaeger, Laredo; Thos. D. Miller, Dallas; R. S. Wakefield, San Antonio, Geo. H. Cushman, San Antonio; F. E. Scovill, Austin; C. L. Wakefield, Dallas; W. E. Holmes, Austin; J. H. Fitzgerald, Houston (by proxy).

After discussion it was decided to hold a joint meeting of both associations at Laredo, Texas, on these days, March 9, 10, 11 and 12, 1898. A letter was read from Mayor Christen, of Laredo, saying that he and citizens of Laredo, would do all possible to successfully entertain members, delegates and visitors. Mr. Yaeger stated that every preparation for the comfort and convenience of members, delegates and visitors would be made by the citizens of Laredo. Hotel accommodations would be ample. The hall for meeting would be provided; a large and convenient hall with light and power service would be available for exhibits and local committees would arrange attractive programmes for entertainment of all in the intervals between business sessions.

Mr. Yaeger further said that the Mexicans who were connected with the lighting, street railway and power plants of the Republic of Mexico, had evidenced great interest in the proposed meeting and that the Mexican Government had, through its Department of Foreign Affairs and through Senor P. Ornelas, Mexican Consul at San Antonio, expressed interest in and tendered offers of assistance as far as possible, for a successful meeting and that a large attendance was expected from Mexico.

It was then moved and carried that an International Meeting of the Texas Gas and Electric Light Association, the Texas Street Railway Association and the Gas, Electric, Street Railway and Power men of Mexico, be held as above and that the joint invitation of both associations be extended to our Mexican neighbors and that a part of the programme be devoted to papers to be prepared by them.

After further discussion a general programme was outlined for separate and joint meetings, including: "The Advantages of Associate Work," by Carl F. Drake, of Austin; "Meter vs. Flat Rates," J. R. Cullinane, Dennison; "Use and Abuse of Electrical Machinery, Apparatus and Appliances" Harry L.

Monroe, Dallas; "A Chapter on Accidents," Geo. B. Hendricks, Fort Worth; "Uniform Voltage and Continuous Service," George R. Cushman, San Antonio; "Street Mains and Services," J. H. Fitzgerald, Houston; "The Ups and Downs of the Manager," J. D. Oliger, Cleburne; "Car Bodies; Their Maintenance and Repairs," Frank E. Scovill, Austin; "Trucks and Their Maintenance," George D. Hartson, Dallas; "Instantaneous Water Heaters," Thos. D. Miller, Dallas; "Experiments in Efficiencies," E. F. Gibbon, Corpus-Christi; "Rail Bonding as a Power Saver," H. C. Chase, Houston; "The Electric Furnace; Calcium Carbide; Acetylene Gas and Other Forms of Gas," J. D. Cox, Galveston; "Rates for Electric Lighting," E. L. Wells, Jr., Marshall; "Miscellaneous Matters," W. L. Hall, Mexia; "Ties; Their Life and Preservation," D. D. Willis, San Antonio.

An interesting programme of miscellaneous entertainments is also being laid out.

Meeting of the Northwestern Electrical Association.

THE sixth annual convention of the Northwestern Electrical Association was held at Milwaukee, Wis., at the Hotel Pfister, Jan. 19-21, 1898. The following members and guests were in attendance:

E. H. Abadie, St. Louis; Jas. Atkinson, M. B. Austin, Mrs. M. B. Austin, E. D. Alexander, Chicago.

F. R. Bacon, Milwaukee; E. K. Batton, Chicago; W. Worth Bean, W. Worth Bean, Jr., St. Joe, Mich.; C. L. Burlingham, F. B. Badt, Mrs. F. B. Badt, F. N. Boyer, Chicago; L. W. Burch, Madison; B. L. Burdick, Milwaukee; C. W. Bacon, Madison; F W. Buss, Chicago; W. P. Bragg, Monroe; C. E. Brown, Chicago; M. Brooks, Minneapolis.

Jac. Cloos, Chicago; H. O. Channon, Freeport; L. M. Cole, A. B. Conover, Geo. Cutter, Mrs. Geo. Cutter, Chicago; F. A. Copeland, La Crosse; A. G. Collins, Milwaukee; A. A. Cross, J. V. S. Church, Chicago; W. L. Church, Milwaukee; J. H. Callouck, Freeport; W. P. Clausen, Frank H. Clark, J. H. Culver, Chicago; W. F. Collins, Warsau.

B. B. Downs, Fred De Land, Chicago; Thos. Duncan, E. R. Draffen, Ft. Wayne; E. L. De Bell, Sheboygan; G. A. Davis, Newark; Alex. Dow, H. L. Doherty, Detroit; A. Donohue, Chicago; Jas. R. Dee, Houghton.

— Eberhardt, W. H. Edgar, Chicago; S. Ellis, Milwaukee; Axel Ekstrom, New York.

A. W. Foster, Chicago; Thos. Ferris, Milwaukee; A. O. Fox, Madison; Hy. Floy, Chicago; F. H. Ford, Madison; E. A. Fox, Chicago.

Ch. P. Gage, Chas. Girjahn, Thos. S. Grier, Ed. R. Grier, Wm. Goltz, Chicago; H. J. Gille, St. Paul; T. F. Grover, Fond du Lac; A. C. Garrison, St. Louis; C. G. Guild, Chicago; C. R. Edman, Milwaukee.

Geo. Hurd, F. S. Hunting, Ft. Wayne; L. A. Hine, J. H. Harding, B. Hartley, E. H. Hammond, J. M. Hill, Chicago; P. F. Harloff, Madison A. D. Hamacek, Sturgeon Bay; H. C. Higgins, Marinette; Geo. W. Stauntton, Chicago.

Prof. D. C. Jackson, Madison.

F. G. Kurz, Appleton; J. M. Knox, Chicago; C. S. Kehler, Milwaukee; C. E. Kammeyer, Chicago; Frank Kellogg, Spencer; A. L. Kuehmstead, Chicago; H. R. King, Milwaukee; C. A. Kehler, Chicago; L. E. Kerns, Madison; P. H. Korst, Racine; O. P. Kissell, Hartford.

J. S. Loomis, H. E. Lang, W. W. Lowe, R. D. Lucas, A. M. Little, Chicago; A. C. Langstadte, Appleton; Otto Langstadt, La Crosse; S. B. Livermore, Winona; A. E. Lucas, Marion; C. E. Lukens, Chicago; J. P. Lord, Waupaca.

N. W. Mixer, J. H. McGill, J. B. McKeague, Chicago; J. S. Maurer, Fostoria; B. M. Myers, Chicago; T. R. Mercein, Milwaukee; C. D. Marsh, New York; W. J. McConnell, J. B. Morrill, J. C. McMynn, — McRoy, Chicago.

F. D. Nims, Muskegon; Pliny Norcross, Janesville.

J. B. O'Hara, Chicago.

R. J. Parvin, Geo. Peck, J. C. Pomeroy, F. L. Perry, Chicago; E. L. Powers, New York; Geo. W. Patterson, Chicago; H. A. Pierce, Negaunee; F. A. Pamperin, Oconto; C. C. Paige, Oshkosh; C. T. Page, Chicago.

F. Raymond, T. D. Retchie, Chicago; J. E. Randall, St. Louis; W. S. Rugg, Chicago; Geo. F. Rohn, Milwaukee; Geo. P. Rex, I. D. H. Ralph, C. A. Ross, Jul. Roe, Chicago.

W. H. Schott, Chicago; A. C. Shaw, New York; B. J. Shockley, Geo. S. Searing, R. F. Schuchardt, Chicago; F. L. Stagg, Madison; R. A. Swain, W. R. C. Smith, C. M. Smith, Chicago; B. H. Strong, Barraboo; Ed. Schuette, Maintown.

W. J. Trott, A. L. Tucker, Chicago; G. M. Thayer, Belle Plaine; A. A. Thompson, Madison.

H. G. Underwood, W. P. Upham, Chicago; E. A. Upham, Mansfield; C. E. Van Bergen, Okonto; Geo. S. White, J. M. Worrell, Jas. C. Wormley, W. Wadhams, Chicago; E. A. Wuerster, Milwaukee; W. H. Whiteside, Chicago; T. F. Whitefield, Milwaukee; Jas. Wolfe, Chicago.

G. E. Yorke, Portage.

The convention was called to order by the president, Mr. H. C. Higgins, of Marinette, Wis., who read an address.[1]

The secretary and treasurer, Mr. Mercein, then presented his report, in the course of which allusion was made to the fact that the National Electric Light Association purposed to make a full discussion of the Municipal Ownership question one of the prominent features of the Chicago meeting next June.

WEDNESDAY AFTERNOON SESSION.

The chair appointed a committee of three to nominate officers and directors for the ensuing year. The election resulted as follows: President, Mr. F. A. Copeland, of La Crosse; first vice-president, Mr. James R. Doe, of Houghton, Mich.; second vice-president, Mr. P. H. Korst, of Racine, Wis.; secretary and treasurer, Mr. Thomas R. Mercein, of Milwaukee. Directors, Mr. E. L. Debell, of Sheboygan, Wis., chairman; Geo. L. Thayer, of Belle Plaine, Iowa; S. B. Livermore, of Winona, Minn.

PRESIDENT F. A. COPELAND, of La Crosse, in assuming the chair, congratulated the association on the gait it had kept up since its organization, and stated that the object of the association was to stand by and aid those engaged in a legitimate business.

MR. PLINY NORCROSS, chairman of the Protective Committee, then presented the report of that committee. This committee had met at Madison several times during the session of the legislature of 1897. Of the 83 electric companies in Wisconsin, probably not five were represented in the legislature at any one time. A bill had been passed taxing every electric light and railway company 1½ per cent. on its gross receipts.

The Milwaukee Street Railway and Electric Light Company paid a tax of $63,000. It was suggested that when the committee for another year is appointed some member of that committee should be a resident of the city of Madison.

Various excursion plans were discussed in connection with the summer meeting. A paper was then read by Mr. Alexander Dow, of Michigan, on "Electric Lighting for Profit."

MR. THAYER: I would like to ask Mr. Dow one question: In a large number of the smaller plants in towns of from 3,000 to 8,000 inhabitants, we find a combination of alternating and direct current series arcs. How would you recommend to handle a power load, by installation of direct current plant or going right ahead on alternate current lines?

MR. DOW: If you have a plant of that kind you are in the hole. I will not say whether you are to blame for being in that hole, but if you can get after the man who put you in—mark him down as not knowing his business or as being over-anxious to sell you the plant. How can you get out? I cannot recommend now any general prescription. There are two good methods of establishing a new plant or reorganizing an old plant, one is the so-called monocyclic system, which is a good system, and you can get arcs to run from it nicely—the new enclosed arcs do nicely on it—and it is for the general class of country towns and attendants a very satisfactory kind of a plant. Only do not make the mistake of putting in 2,200 volts if a little more copper will let you out with 1,100. You will have about three times as much trouble with wires and nine times the trouble with lightning with the higher pressure than you would if you stayed at the lower pressure.

The other plant is open to anybody, there being no patent in force, the 240-volt distribution. It is highly satisfactory. The unsteadiest kind of a power load is an elevator, but my station is successfully handling elevators during the daytime three miles from the station. We give bad lighting in the daytime, but the lighting from dusk to 11 o'clock is very good. If you can tell your customers plainly that the current will be on in the daytime, and that they should take what they get in the daytime and be thankful, and tell them that motors will run steady if the load is steady, they will be satisfied, and you can cover a tremendous amount of territory with your copper; only see that the two loads do not interfere. In most cases they do not interfere. Spend enough money for copper to begin with. That means, of course, no dividends for two or three years, and the man who sells the goods to you should say: "See here, are you willing to see this thing grow up until there is enough business to pay interest on the copper, or do you wish to begin to cash in your chips right away? If you do, you had better try the alternating system; but if you want a profit by and by with a pretty sure thing of it, try the other." The direct current system, 220 to 240 volts, has not yet been properly exploited, and I think it is the one that will cover the most small towns that my friend has spoken of. Outside of that is the monocyclic system, which is very satisfactory, and I would speak of it even more freely if it were not a system controlled by one company.

The subject of Municipal Ownership was taken up and discussed in executive session.

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[1] See page 111.

The president appointed a committee on location of summer meetings, and the meeting adjourned until the following morning.

THURSDAY SESSIONS.

At the Thursday morning session LIEUT. FRANCIS A. BADT, of Illinois, made an address on "Topics of Interest to Central Station Men."

MR. W. H. EDGAR then addressed the meeting on the subject of "Physical and Chemical Properties of Volatile Oils in Boilers." The discussion which followed brought out some valuable points on boiler incrustations.

MR. DE LAND, of Chicago, read a paper written by Mr. John C. McWynn, of Chicago, on the subject of "Practice of Theory."

MR. JOHN E. RANDALL, of St. Louis, then presented a paper on "Present Efficiency of Incandescent Lamps."

The afternoon session was devoted to a discussion of a paper by PROF. R. B. OWENS, of the University of Nebraska, on "Electricity in Municipal Engineering," and a paper by MR. FRED De LAND on "Municipal Socialism." A very interesting discussion followed which was practically a continuation of the discussion begun by Mr. Dow, of Detroit, on the previous day, by Messrs. Norcross, Livermore, Thayer, Doherty, Bean, Thorpe, Pearce, Debell, Dee, De Land and Prof. Jackson, who gave valuable suggestions on the subject of depreciation and on the training of central station men. The committee on midsummer meeting then presented their report, recommending that the association do not hold a summer meeting in 1898. The report was accepted, and committee discharged. A committee of five was appointed to consider the advisability of holding a midsummer meeting and report before April 1, 1898.

The president and secretary were appointed to represent the association at the next meeting of the N. E. L. A. at Chicago.

The association met for routine business on Friday morning and then adjourned sine die.

Convention Notes and Exhibits.

THE CROCKER-WHEELER ELECTRIC COMPANY was represented by their Western manager, Mr. Julian Roe.

MR. H. J. GILLE, of the Chicago office of the Washburn & Moen Manufacturing Company, had a pleasant word for every one.

MR. A. J. STAHL, of the Yaryan system of steam heating, La Porte, Ind., was on hand busily expounding the virtues of his system to central station managers.

J. C. WORMLY occupied parlor 5, which was thronged continuously with his many friends. He exhibited a full line of Wormly & Shelby incandescent lamps ranging in voltage from 45 to 220 volts, and up to 50 candle power; also an assortment of miniature lamps from 2 volts upwards and 1-5 candle power upwards. In the rear of the parlor a neat switchboard was arranged, showing various styles of lamps. The filament exhibit consisted of squirted cellulose in the liquid form, threads before and after drying, carbonized and mounted, treated. There was also an exhibit of cut filaments made exclusively by Prof. A. A. Chaillet, technical manager of the Shelby Electric Company, Shelby, O.

MR. W. L. CHURCH, general manager of the lighting department of Milwaukee Lighting and Railway Company, busied himself getting the "boys" in line to attend a local theatre; about 100 took advantage of the opportunity and the entertainment was hugely enjoyed.

THE DEARBORN DRUG AND CHEMICAL COMPANY were represented by Mr. Chas. S. Kehler and Mr. W. H. Edgar, proprietor, who made many new friends.

SARGENT & LUNDY, engineers, Chicago, were ably represented by Mr. T. E. D. Richie, who expounded the qualities of C & C dynamos and motors, Fort Wayne incandescent lamps and Paragon fan motors.

THE EXHIBIT of the People's Electric Company, Madison, Wis., was in charge of F. H. Ford and C. W. Bacon. Among the many specialties which they showed were "Northern" generators and motors in operation, of which they are general selling agents; the Ritter soldering iron, of their own manufacture; "Enamelac" insulating paint, Peerless armature compound, "Perfection" dynamo brushes; "Grimshaw" and "Raven Core" wire, O. K. dry batteries, "Fagan" cutout, and various other specialties.

MR. W. W. LOW, the genial and energetic president of the Electric Appliance Company, was kept busy greeting his many friends in the trade.

THE CENTRAL ELECTRIC COMPANY, of Chicago, occupied parlor 6. They interested and entertained many friends with the latest improved Edison phonograph. Their interests were looked after by Chas. E. Brown, secretary, and Mr. W. P. Upham.

WESTERN ELECTRIC COMPANY, Chicago, were represented by Mr. H. L. Tucker, Thos. G. Grier and A. M. Little. They exhibited a full line of beautiful half-tones of desk and ceiling fans for direct and alternate current and the W. E. enclosed arc lamp. A pretty announcement was distributed which stated that the company are now headquarters for all sizes of Okonite wires and cables as well as Okonite and Manson Tape.

BRYANT ELECTRIC COMPANY, Chicago, was represented by Edward R. Grier, whose numerous friends gave him a hearty greeting.

McGILL & POMEROY, the two specialty stars, dropped in on the convention Wednesday; they extended the glad hand to their many friends.

MYSENBERG & BADT, Chicago, had a pretty exhibit of Hardy incandescent lamps, including the new 220-volt lamp; arc lamp hanger boards, Helios enclosed arc lamps, etc. Prof. F. B. Badt and R. F. Schuchardt were in attendance.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, had a neat exhibit of a Tesla two-phase motor and a new high voltage switchboard, both of which commanded great attention. The exhibit was in charge of W. H. Whiteside, Chicago representative, and Mr. J. E. Rugg, of Pittsburg.

THE interests of the Safety Insulated Wire and Cable Company were looked after by Mr. M. B. Austin, of Chicago.

BRYAN-MARSH COMPANY, who occupied parlor 12, showed a novel and interesting product, a new double-filament lamp, 110 to 220 volts. For the first time at a convention was exhibited a spark coil for the purpose of illustrating the manner of testing the vacuum of lamps. Many central station men were interested in ascertaining that they could at a small expense test the vacuum of their own lamps and not depend upon the claims made by manufacturers. Converse D. Marsh was among the longest dinstance visitors, having come from New York for the sole purpose of attending the convention. Mr. Jos. M. Hill, the Western manager, had charge of the exhibit.

VITRO-CHROME CHEMICAL COMPANY, Milwaukee, occupied parlor 8, showing a handsome switchboard with an assortment of colored incandescent lamps burning. They claim their colored lamps will withstand severe outdoor weather without affecting the colors which are dipped (but not collodion). Their zero frost lamp attracted much attention.

THE ELECTRIC SUPPLY COMPANY, of Madison, Wis., was represented by F. L. Stagg, secretary and treasurer, and L. W. Buch, president.

THE ELECTRIC STORAGE BATTERY COMPANY was ably represented by Mr. F. H. Clark, the Chicago manager, and R. B. Daggett, one of the company's engineers.

MR. A. G. CLAUSEN, chief electrician of the Goodrich Transportation Company, took a great interest in the proceedings of the convention.

CHAS. E. GREGORY COMPANY was represented by their popular president, Mr. A. Louis Kuehmstead, a description of whose splendid new quarters will be found in another column.

CHAS. E. GREGORY was on hand in the interest of the Elliptical Carbon Company, of Chicago.

CRANE COMPANY had Mr. C. H. Hurd on hand for information and circulars.

WAGNER ELECTRIC AND MANUFACTURING COMPANY, St. Louis, had a splendid exhibit of two-phase

motors showing their latest type and presenting some novel features. A full line of transformers and switches was also shown, as well as their 15 h. p. generator. All this apparatus as usual was of admirable design and beautiful workmanship. Mr. A. H. Abadie was in charge and met with a very cordial and hearty reception, being busy besides in answering inquiries after apparatus.

MR. T. R. MERCEIN'S efforts have assisted the convention materially in making it a great success, and he has made a host of new friends.

MR. JAS. F. CUMMINGS, Amorite, Pittsburg, was late in arriving, but he was none the less welcome. No electric light convention seems complete without "Jim." His friends, ever solicitous of his personal comfort, had provided for his coming; a large keg of Milwaukee's best had been placed at the foot of his bed. On the keg was a masterpiece of poesy.

THE FORT WAYNE ELECTRIC COMPANY had a very interesting exhibit of enclosed arc lamps and meters, all in operation. The new Duncan wattmeter has met with great success and has several very interesting and novel features. A very ingenious device is used in this meter for balancing the friction of the bearings so that it is possible to make meters of even 1,000-light capacity that will start on one 16-candle-power lamp. This device can also be used to compensate for small differences in voltage and also to overcome the tendency to creep if installed in a place where there is vibration. The jeweled lower bearing in this meter is supported on a spring which saves many jewels from being broken in installing. This meter is claimed to be absolutely accurate on all loads and all sizes from 1 to 100 lights, will register on a 4-candle-power lamp and any meter up to 1,000 lights capacity will start on one 16-candle-power lamp. Several types of enclosed arc lamps were shown in operation, including 110 and 220-volt D. C. lamps, and A. C. lamps. The 220-volt D. C. lamp is designed as are all other types for that matter to burn singly on their respective circuits. The A. C. lamps are built for any frequency and are operated either from a regular transformer with an economy coil in the lamp or from their well-known special arc lamp transformer without any resistance or economy coil in the circuit. This latter method of operating these lamps is more efficient than any other as practically all the energy in the lamp circuit is expended in the arc itself. These lamps are ornamental in design and furnished in several finishes. The Fort Wayne Electric Corporation were represented by Mr. E. L. Draffen, of Chicago, and Mr. Thos. Duncan and Mr. F. S. Hunting, of Fort Wayne. Mr. C. G. Guild, manager of the Jenney E. L. & P. Co., Fort Wayne, Ind., was also with the Fort Wayne delegation.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, was represented by Secretary and Treasurer H. C. Garrison, also by J. E. Randall, and Geo. P. Rix, manager of the Chicago office of the company. Mr. Garrison showed a line of lamps representing the different styles made by the Columbia Company, also a number of 220-volt lamps. In addition to lamps the exhibit included material showing the different stages of the filament, the liquid in its original state, the threads before carbonization, the treated filaments ready to be sealed in, etc. A number of the original Goebel lamps were also shown and proved of much interest.

EVERYBODY calls George Learing "Uncle." E. R. Grier, the Western representative of the Bryant Electric Company, is the father of a bouncing boy and now George Learing is figuring whether he is an uncle to the boy or a granduncle. As the Western representative of the Hart Company and an adopted granduncle of the recent addition, he feels his dignity weigh heavily upon him.

A. C. FOSTER, of Foster & Lewis, Chicago, engineers and contractors, represented the Triumph Electric Company, of Cincinnati.

JAMES WOLFF, Chicago representative of the New York Insulating Wire Company, was on hand and frequently in evidence.

ROHN & MEYER, State agents of the Helios Electric Company, exhibited a full line of Helios lamps in charge of B. L. Burdick.

CHICAGO INSULATED WIRE COMPANY was represented by W. M. Smith.

SOME MEN are fortunate in the names they bear, but none so fortunate as the genial Ned Fox, the Western representative of the Phœnix Glass Company. Mr. Fox has made use of his name for an advance card by having a picture of a fox to represent him. His earlier cards had a poor, lean-looking animal, but his most recent card has a sleek, fat, well-dressed fox, showing how well he has prospered. Some day you will see the card; then will shortly follow the portly form of everybody's friend—Ned Fox. He was at the Milwaukee convention.

THE ELECTRICAL PRESS was, as usual, well represented, as follows: Frank E. Perry, R. J. Parvin, J. B. O'Hara, "Western Electrician"; C. E. Kammeyer, "Electrical Review"; Fred de Land, "Electrical Engineering"; W. R. C. Smith, "American Electrician"; J. V. S. Church, "Electrical World"; E. L. Powers, C. E. Lukens, "American Electrical Directory"; A. C. Shaw, W. J. MacConnell, "The Electrical Engineer."

THE AMERICAN RHEOSTAT COMPANY'S exhibit consisted of one ½-horse-power 110-volt, one 5-horse-power 110-volt, one 7½-horse-power 110-volt automatic starter, and the front of a 100-horse-power 110-volt automatic starter, one 5-horse-power 220-volt speed controller, one 40-kilowatt 110-volt rear of switchboard field rheostat, one 3-kilowatt 115-volt wall type field rheostat, one 50-horse-power 220-volt Perfection starter, one front for a 20-horse-power 220-volt Perfection starter, one controller for sewing machine work, and one 10-horse-power 220-volt reversible elevator controller. F. R. Bacon, president, and J. G. Hickox, treasurer, of the company, were in attendance.

Armour Institute of Technology—W. H. Merrill on Fire Hazards.

MR. WILLIAM H. MERRILL, JR., electrician for the National Board of Fire Underwriters, delivered a lecture on Electrical Fire Hazards to the students of Armour Institute of Technology, Jan. 18. He divided the fire risks into eight classes, as follows: 1. Crosses between ærial wires of different systems. 2. Grounds and short circuits on electric light and power systems. 3. Wooden-based devices. 4. Transformer breakdowns. 5. Sparks from arc lamps. 6. Poor contacts and connections. 7. Heating effects of incandescent lamps. 8. Miscellaneous troubles from (a) cutouts; (b) switches; (c) rheostats; (d) motors and dynamos.

He recommended that transmission circuits, and even isolated plants, especially where the conductors pass from one building to another near by, should be put in underground circuits, unless there are good economic reasons for overhead construction. If this practice becomes general, fires of electrical origin will be much less numerous than at present, and a great many troubles which are destructive to apparatus will be avoided. He emphasized the danger of loose contacts, joints or connections when placed near inflammable substances, such as wood or fiber insulation.

These remarks were strikingly illustrated by numerous examples which had been collected by the inspectors. The necessity for some adequate earthing device to protect the secondary of the transformer from the primary e. m. f. was pointed out, and certain recent pieces of apparatus to accomplish this were described. He believed that the attempt to prevent the primary from short-circuiting with the secondary could not be reliably accomplished by increasing the thickness and character of the insulation. The fire hazard with transformers is very great when high electromotive forces accidentally get in the primary coil. In one instance, lightning burned through to the secondary coil and punctured the gas pipe in four or five chandeliers just at the insulating joint, and ignited the escaping gas, thus starting four or five simultaneous fires in the house.

Manufacturers to Meet.

The third annual convention of the National Association of Manufacturers will be held in Masonic Temple, corner Sixth avenue and Twenty-third street, on Jan. 25, 26 and 27. There will be three sessions on the first two dates and two on the last. Reports of officers and committees will be presented on Tuesday afternoon.

LEGAL NOTES

Decision as to Motor Suspension.

Sprague Elec. Ry. & Motor Co. *vs.* Union Ry. Co. and Walker Mfg. Co.

JUDGE WHEELER in the U. S. Circuit Court for the Southern District of New York has just handed down a decision in favor of the complainants in this case, under the Sprague patent No. 324,892, of August 25, 1885, for an electric railway motor consisting of a field magnet journaled on the axle of the driving wheels at one end, and hung upon a spring from the truck or the car body, at the other; and carrying the armature shaft upon its pole pieces parallel with the shaft of the driving wheels, and connected to them by gearing. The claims in question were the second, sixth, and ninth. The court says: "The defendants' structures differ in some respects from those of the patent, but have all these parts working together in the same relation to each other, for the same purpose and producing the same result. They are altered by the addition of a joint in the motor, and of another spring to help carry it, but not by dispensing with any of the parts; they are improved upon but not departed from. The defendants' improvements are not made independent of, and clear from, Sprague's but upon his; and his patent appears to be infringed by this taking of his invention to improve upon." The Sprague Company's patents of that time are, of course, now owned by the General Electric Company, which has in reality brought the suit. For the plaintiffs F. H. Betts appeared, and C. E. Mitchell and H. B. Brownell for the defendants.

Recent Street Railway Decisions.

Running an electric car at an unusually rapid rate over a much frequented crossing, when the usual rate was from 12 to 14 miles per hour, was held, in Evansville St. R. R. Co. vs. Gentry (Ind.) 37 L. R. A. 378, to be such negligence as constitutes little less than wanton and reckless disregard of human life. But it is held that some slight proof at least of a want of contributory negligence was required in case of a man killed by the car and found about 45 feet from the crossing, at which he had stepped from another car.

The exemption of a street railway from a license tax is held, in Springfield vs. Smith (Mo.) 37 L. R. A. 446, not to be granted by a mere grant of the privilege of operating the road for a term of years, if the license tax is imposed under statutory authority, although for revenue purposes, and not simply for police regulation.

Driving a fire truck to a fire so rapidly that on approaching an electric street car track it is impossible to stop in time to avoid a probable collision is held, in Garrity vs. Detroit Citizens' St. R. R. Co. (Mich.) 37 L. R. A. 529, to constitute negligence on the part of the driver, although by the city ordinance he has the right of way.

A New York State Telephone Rates-Reduction Bill.

The first telephone rates-reduction bill of the session has been introduced by Assemblyman Cain (Dem.), of Brooklyn. It provides that six months after the passage of the act the charge for the annual or monthly use of a telephonic communication, both by day and night, together with such instruments and electrical apparatus as shall be necessary to transmit vocal messages between the patrons or subscribers of any telephone company within the limits of this State (which charge and price shall be pro rata for shorter periods) shall be, in cities of one million inhabitants and over not to exceed a rate of $85 per annum; cities of 500,000 and less than a million, not to exceed $75; in cities of 500,000 and less than a million, habitants, not to exceed $48; in cities of 20,000 and less than 100,000, not to exceed $36; in places of 8,000 and less than 20,000 inhabitants, not to exceed $30, and in all cities and places of less than 8,000 not to exceed $27. The population as ascertained in the United States census of 1890 shall be the basis upon which the rates shall be fixed, and when the rates have been so fixed they shall not be thereafter increased by reason of an increase of population in any city or place in the State.

The charges at public pay stations in any place shall not exceed ten cents for the first five minutes after connection is made, and five cents for each five minutes or part of five minutes thereafter. No yearly or monthly patron or subscriber having and paying for a telephone at his own home or office shall be charged for the use of a telephone at a public pay station, when used by him or his employees for communicating with his own home or office, and all subscribers shall be furnished with certificates entitling them to such free use of pay stations.

The Comptroller, Attorney-General, and State Engineer and Surveyor, within thirty days after the passage of the act, shall meet at Albany for the purpose of carrying into effect its provisions, and thereafter at the same place once each month, and at such other times and places as the purposes of the act may require. They shall investigate all complaints, and in their discretion if a company is losing money or in any financial distress may increase the rate.

MARRIED

Hull—Linke.

J. F. Hull, superintendent of the Polk County, Missouri, Telephone Line, and Miss Flora Linke, both of Humansville, Mo., were married recently over the telephone wire. The groom was at Bolivar, Mo., while the bride was at Humansville. There was a minister at each end of the wire with the required number of witnesses. All parties were acquainted with one another and recognized the various voices, so that the witnesses are prepared to swear, if the question is ever raised, that they know that the ceremony was properly performed.

OBITUARY

Oliver B. Shallenberger.

IT is with deep regret we record the death at Colorado Springs, Colo., of Mr. O. B. Shallenberger, who had sought health in that section of the country for some time past, on account of the weakness of his lungs. Although barely 38, he had done much to make himself remembered in the development of electric light and power in America. He was born at Rochester, Pa., and at the age of 17 entered the United States Naval Academy at Annapolis, where he graduated in 1881. After two years' active service afloat, he resigned his commission, and became engaged in the experimental work of the electrical department of the Union Switch and Signal Company, which at that time had undertaken the manufacture of the Stanley continuous current apparatus. When the Westinghouse Electric Company was organized in January, 1886, and the great development in alternating current came, Mr. Shallenberger was appointed chief electrician. He held this position with much credit until his health broke down, four or five years ago, and he was compelled to seek the dry air of Colorado. During his active career he made numerous inventions, one of which was the beautiful Shallenberger meter. He became a member of the American Institute of Electrical Engineers in 1888. The body of Mr. Shallenberger has been brought East, and the funeral will take place at Rochester, Pa., at 10 a. m. on Saturday, January 29.

MR. B. BUTTERWORTH, U. S. Commissioner of Patents, died last week in the South, whither he had gone in search of health. He was born in 1822, and had been active in national politics as a Republican all his life. He served also as Commissioner of Patents in the eighties.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued January 4, 1898.

Alarms and Signals:—

ALARM CLOCK ATTACHMENT. P. C. Howe, Boston, Mass., 596,680. Filed April 15, 1897. Comprises an alarm clock, operated by a thermostat for releasing the alarm train of the clock and of a circuit-breaker operated by alarm-train.

ELECTRIC SIGNALING APPARATUS. F. B. Herzog, New York, 596,774. Filed May 31, 1895. Annunciator.

EXHIBIT PROTECTOR. H. J. Olney, Cedar Rapids, Iowa, 596,824. Filed March 13, 1897. Comprises a pneumatic tube located between two platforms and an alarm mechanism actuated by the movement of the diaphragm of the tube.

ELECTRIC CLOCK. F. Richard, Lynn, Mass., 596,943. Filed Aug. 21, 1896. Details of construction.

AUTOMATIC TEMPERATURE REGULATOR. A. A. Boss, Detroit, Mich., 596,955. Filed March 31, 1897. Means for actuating the draft controlling mechanism of heaters, so that the dampers of the heater may be automatically opened and closed.

Batteries, Primary:—

VOLTAIC BATTERY. H. E. De Rufz De Lavison, Neuilly-Sur-Seine, France, 596,791. Filed May 28, 1897. The depolarization of the negative electrode is effected by heat.

Conductors, Conduits and Insulators:—

PRESS FOR MAKING INSULATORS. Henry M. Brookfield, New York, N. Y., 596,651. Details of construction.

PRESS FOR MAKING INSULATORS. Henry M. Brookfield, New York, and S. Krits, Brooklyn, N. Y., 596,652. Filed January 2, 1897. Similar to above.

PRESS FOR MAKING INSULATORS. S. Kribs, Brooklyn, N. Y., 596,682, Filed January 30, 1897. Similar to above.

Distribution:—

CONVERTER FOR MONOPHASE CURRENTS. A. Blondel and G. Sautter, Paris, France, 596,567. Filed June 27, 1895. Comprises an armature having a primary and a secondary winding, surrounded by a closed magnetic frame, a tertiary winding relatively stationary with reference to the magnetic frame, and a quarternary exciting winding.

Dynamos and Motors:—

ELECTRIC FAN. O. F. Conklin, Springfield, Ohio, 596,483. Filed June 17, 1897. Ceiling fan. Details of construction.

Electro-Metallurgy:—

APPARATUS FOR EXTRACTING GOLD, ETC., FROM DRY CRUSHED ORES. E. L. Oppermann, London, Eng., 596,535. Filed March 11, 1897. Mercury vapor and steam are blown under pressure upon the crushed ore and the metal is extracted magnetically.

PROCESS OF AND APPARATUS FOR UTILIZING WASTE PRODUCTS OF BLAST FURNACES. H. L. Hartenstein, Bellaire, Ohio, 596,704. Filed October 27, 1896. Consists in mixing slag with carbonaceous material. Injecting a reducing gas and subjecting the whole to the action of an electric current.

PROCESS OF UTILIZING WASTE PRODUCTS OF BLAST FURNACES. H. L. Hartenstein, Bellaire, Ohio, 596,705. Filed October 27, 1896. Similar to above.

MAGNETIC ORE SEPARATOR. L. G. Rowand, Camden, N. J., 596,719. Filed April 16, 1897. Comprises a conveyer belt carrying the material to be treated, a discharging belt passing over and at an angle with the conveyer belt, a magnet above the belts at the crossing point and extending above the discharge-belt beyond the conveyer belt.

MAGNETIC ORE SEPARATOR. L. G. Rowand, Camden, N. J., 596,720. Filed April 15, 1897. Similar to above.

PROCESS OF UTILIZING WASTE PRODUCTS OF BLAST FURNACES. H. L. Hartenstein, Bellaire, O., 596,749. Filed October 27, 1896. Similar to 596,705.

Lamps and Appurtenances:—

MEANS FOR VARYING CANDLE POWER OF INCANDESCENT ELECTRIC LAMPS. C. E. Felch, Natick, Mass., 596,582. Filed June 21, 1897. Includes in circuit between the line and the lamp filament a permeable resistance medium adapted to be entered to a greater or less depth by an electrode also included in the circuit.

PROCESS OF PRODUCING HIGH VACUUMS. E. F. Dwyer, Lynn, Mass., 596,654. Filed October 26, 1897. Consists in pumping out the main portion of the gases, heating the remaining gas while continuing the pumping, driving off occluded gases, and producing a condensable gas by an electric current passed through a circuit within the receptacle, and finally sealing.

SUPPORT FOR ELECTRIC LAMPS. O. C. White, Worcester, Mass., 596,729. Filed February 16, 1897. A support, a pipe pivotally connected thereto, a ball secured to the end of the pipe, an electric lamp fixture, a ball connected thereto, yoke pieces, and a single clamping device for adjustably clamping the pieces into engagement with the balls.

Miscellaneous:—

ELECTRIC OVEN. L. E. Custer, Dayton, Ohio, 596,696. Filed March 16, 1896. Details of construction.

SAFETY MAGNET-BRAKE. John D. Ihlder, Yonkers, N. Y., 596,514. Filed September 21, 1896. An automatic safety brake device, combined with a mechanical brake which operates to set the safety brake.

COMPOUND BRAKE FOR ELECTRIC ELEVATORS. John D. Ihlder, Yonkers, N. Y., 596,513. Filed September 14, 1896. Comprises a spring-compression device connected with the brake; a direct, positively-acting device, also connected with the brake, and means for operating both devices.

APPARATUS FOR STERILIZING AND PURIFYING WATER. N. Van Der Sleen, Haarlem, and A. Schneller, Netherlands, 596,917. Filed August 31, 1895. Comprises a vessel having in its bottom an inlet for the ozone employed, nozzles adapted to atomize the water to be sterilized, the nozzles being arranged so as to converge toward each other, as well as toward the inlet for the ozone.

Railways and Appliances:—

SUBTERRANEAN ELECTRIC CONDUIT. W. D. M. Howard, Redwood City, Cal., 596,812. Filed June 18, 1897. Underground railway conduit system.

ELECTRIC CABLE FOR PROPULSION OF VEHICLES. A. Norman, Toronto, Canada, 596,907. Filed July 8, 1896. Combines the sectional working conductors with the supply conductor, which forms a coat of protection for the supply conductor.

TROLLEY GUARD. H. J. Vogler and A. Flores, San Antonio, Tex., 596,926. Filed Oct. 16, 1897 Consists of a pair of yielding guards with their springs arranged one on each side of the trolley wheel, which guards hold the wheel on the wire, but yield and pass under the cross supporting wires.

Regulation:—

AUTOMATIC POTENTIAL REGULATOR FOR DYNAMOS. A. A. and P. S. Tirrill, Groveton, N. H., 596,923. Filed May 1, 1897. Details of construction.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRIC SWITCH. W. S. Hill, Hyde Park, Mass., 596,506. Filed May 1, 1896. Means for securing the blades of wrought-copper, yoke and intermediate insulation, or where only one blade is used, the handle and insulation to the end of the blade.

AUTOMATIC STOP MOTION SNAP SWITCH. J. D. Ihlder, Yonkers, N. Y., 596,512. Filed August 11, 1896. Comprises a switch and shaft for operating it, a mutilated gear connected to the shaft, an internal gear, arranged to engage the mutilated gear and a support for the internal gear.

STARTING BOX FOR ELECTRIC MOTORS. J. D. Ihlder, Yonkers, N. Y., 596,515. Filed October 11, 1897. Compries switch and means for moving it, automatic means controlling the shaft, comprising a quick operating device for moving the shaft to operate the switch, and a slow moving device for controlling the movements of the quick moving device.

Telephones:—

TELEPHONE. Wm. Gray, Hartford, Conn., 596,496. Filed April 20, 1896. Embodies a sound passage to the transmitter-diaphragm, a signal box and a tubular connection between the signal box and transmitter case, forming a signal passage, having a deflector located outside of and with its outer surface flush with the wall of the sound passage.

SIGNALING APPARATUS FOR TELEPHONE SYSTEMS. F. J. Holmes, Cleveland, Ohio, 596,509. Filed March 25, 1896. A transmitting and receiving apparatus for code signals for use in connection with telephone or telegraph systems.

SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS. F. R. McBerty, Downer's Grove, Ill., 596,609. Filed October 26, 1896. Comprises an electro-magnet adapted to prevent the display of the indicator when excited, and a mechanical device in the plug socket acting upon the indicator to prevent its display when the plug is present in the socket.

SIGNALING SYSTEM FOR TELEPHONE TRUNK LINES. F. R. McBerty, Downer's Grove, Ill., 596,610. Filed November 24, 1896. A device for causing the act of removing a connection at one of the switchboards, to display the signal at the other switchboard calling for a disconnection of the trunk line.

PLUG AND SPRING JACK FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 596,625. Filed November 29, 1895. Combines a spring jack having a tubular contact-thimble and a contact spring with a plug having a contact-ring for the contact spring, and an insulating ring of larger diameter than the contact ring placed before the latter, whereby it is prevented from touching the contact-thimble.

SPRING JACK FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 596,626. Filed May 14, 1896. Details of construction.

ANNUNCIATOR FOR TELEPHONE LINES. C. E. Scribner, Chicago, Ill., 596,627. Filed May 14, 1896. A momentary signaling current from the sub-station causes the display of the indicator and at the same time closes a circuit of a local source of current through the annunciator to insure its continuous excitement until connection is made with the line.

SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 596,628. Filed November 16, 1896. Details of construction.

TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 596,629. Filed December 8, 1896. Details of construction.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 596,630. Filed December 8, 1896. Contrivance for controlling subsidiary signals associated with connecting plugs in a telephone switchboard.

APPARATUS FOR TELEPHONES. F. B. Cook, Chicago, Ill., 596,806. Filed March 17, 1896. Magneto calling apparatus.

TELEPHONE TRANSMITTER. D. A. Fleming, Indiana, Pa., 596,808. Filed April 12, 1897. Is provided with a curved tube open toward the diaphragm and mounted to turn, balls arranged in the channel, the latter being inclined relatively to the axis of rotation.

TELEPHONE TRANSMITTER. J. H. Spencer and M. S. Keyes, New York, 596,834. Filed January 14, 1897. Is provided with buttons, and granulated German silver held between the buttons.

TELEPHONE SWITCH PLUG. F. B. Cook, Chicago, Ill., 596,850. Filed January 4, 1896. Details of construction.

TELEPHONE APPARATUS. F. B. Cook, Chicago, Ill., 596,851. Filed November 30, 1894. Comprises a combined ringing and listening key.

SWITCH FOR TELEPHONE CIRCUITS. F. B. Cook, Chicago, Ill., 596,852. Filed March 25, 1895. A telephone switch having a pair of crossed springs adapted for contacting at two points on the opposite sides of each, and means for operating the springs whereby to establish or disestablish the contacts.

Classified Digest of U. S. Electrical Patents issued January 11, 1898.

Alarms and Signals:—

ALARM DEVICE. W. E. Downing, Des Plaines, Ill., 596,989. Filed April 20, 1897. Adapted especially to greenhouses to indicate that the temperature of the heating apparatus has fallen below a predetermined degree.

FIRE ALARM. G. A. Townsend, Utica, N. Y., 597,128. Filed May 18, 1897. A circuit is closed by a normally retained spring released by solder melting when the temperature reaches a predetermined point.

Batteries :—

PRIMARY BATTERY. C. J. and H. C. Hubbell, Scranton, Pa., 597,239. Filed May 8, 1897. Embodies a negative element having a central vertical cylindrical enlargement provided at its lower end with a depending lug, in combination with a metallic ring surrounding the lug.

Dynamos and Motors :—

DYNAMO ELECTRIC MACHINE. J. Sohlman, Wiborg, Finland, 597,090. Filed May 22, 1897. Alternating current generator. Details of construction.

STATIC INDUCTION ELECTRIC GENERATOR. A. L. Bogart, Jamaica, N. Y., 597,137. Filed May 5, 1897. Comprises a cylinder made of insulating material, a removable plug therefor, of similar material, metallic contact springs carried by the plug and adapted to contact with the stationary member of the device.

Electro-Therapeutics :—

GRAPHITE RHEOSTAT. E. W. Jewell, Chicago, Ill., 597,002. Filed May 8, 1897. Adapted for use in electro-therapeutical operations.

ELECTRIC TRANSFORMER. J. F. Gates, Pittsburg, Pa., 597,180. Filed January 29, 1897. For therapeutical work.

Lamps and Appurtenances :—

FILAMENT FOR INCANDESCENT LAMPS. E. F. Von Wilmowsky, Boston, Mass., 597,172. Filed September 3, 1896. A filament or conductor for incandescent lighting composed substantially of boron.

COMBINATION GAS AND ELECTRIC LIGHT FIXTURE. J. W. Parkin, Philadelphia, Pa., 597,244. Filed December 23, 1896. Details of construction.

Miscellaneous :—

MAIL-COLLECTION SYSTEM. D. A. Gray, Boston, Mass., 596,993. Filed June 3, 1897. Places the letter boxes in electrical connection with the post office, so that they cannot be opened excepting by operating the keyboard at the post office, which unlocks the box through the medium of electrically controlled locks.

PROCESS OF MAKING CALCIUM CARBIDS. J. E. Hewes, Philadelphia, Pa., 596,909. Filed March 16, 1897. Consists in mixing carbid-producing materials, and a flux containing manganese, and then subjecting the mass to the action of heat sufficient to effect reduction of both compounds.

AUTOMATIC STOPPING MECHANISM FOR ENGINES. V. E. Hunter, Cleburne, Texas, 597,198. Filed June 24, 1897. Means adapted to co-operate with a moving belt, so that in the event of the belt becoming displaced from its pulleys the mechanism will operate to close the throttle valve.

ELECTRIC SEARING-PEN. Henry Green, Hartford, Conn., 597,373. Filed April 16, 1897. Comprises a handle; a cap incasing a resistance medium in which is embedded a searing pen passing through one end of the cap from which it is insulated.

Railways and Appliances :—

ELECTRIC RAILWAY CONDUIT SYSTEM. R. F. Thompson, Alexandria, La., 597,036. Filed July 13, 1897. Details of construction.

INSULATED TROLLEY HANGER. E. J. Cook, Cleveland, Ohio, 597,140. Filed December 2, 1897. Details of construction.

ELECTRIC RAILWAY MOTOR. C. J. Van Depoele, deceased, C. A. Coffin and A. Wahl, administrators, Lynn, Mass., 597,156. Filed June 11, 1890. Comprises a switching device adapted to change the circuit relation of the motors, and means for opening the circuit during such changes at a number of circuit breaking points in series, and independent of the points or contacts where the circuit changes are made.

AUTOMATIC TENDER FOR TROLLEY OPERATING ROPES. C. F. Wilson, Brooklyn, N. Y., 597,159. Filed October 1, 1896. Details of construction.

ELECTRIC RAILWAY. H. W. Libby, Boston, Mass., 597,202. Filed March 10, 1897. Means for propelling, heating and lighting railroad cars by electricity, and in means for telephoning from cars to any desired point.

TROLLEY GUARD. H. F. Hendricks and J. H. Denton, Philadelphia, Pa., 597,282. Filed September 12, 1896. Employs a secondary wheel having a wider groove and capable of lateral travel.

CURRENT COLLECTING MEANS FOR ELECTRIC RAILWAY VEHICLES. C. A. Terry, New York, 597,306. Filed September 17, 1896. A laterally extending contact device in which all of the engaging portion is rotatable.

CONTROLLER FOR ELECTRIC CARS. J. C. Henry, Denver, Colo., 597,374. Filed November 6, 1897. Comprises an electric motor having an armature and field magnet and a trolley having two contacts engaging with the supply-wire, and connected respectively with the armature and field magnet of the motor.

Regulation :—

METHOD OF REGULATING SPEED OF SERIES ELECTRIC MOTORS. H. F. Parshall, London, England, 597,018. Filed April 5, 1897. Employs a line circuit supplying the motor current at constant potential, and a source of electromotive force opposed to that of the line, in shunt to the field magnet circuit of the motor.

CONTROLLER FOR ELECTRIC MOTORS. C. S. Cook, Pittsburg, Pa., 597,265. Filed January 2, 1897. A starting, stopping and reversing switch for electric motor controllers, having two-part brushes for each pair of movable reversing contacts, the parts being being connected by a resistance.

Switches, Cut-Outs, Etc :—

MEANS FOR OPERATING ELECTRIC SWITCHES AND EXTINGUISHING SPARKS THEREOF. J. B. Knudson, Chicago, Ill., 597,150. Filed June 16, 1897. Employs an air-cylinder for blowing the sparks.

ADJUSTABLE SWITCHBOARD. H. H. and F. D. Walker, Philadelphia, Pa., 597,228. Filed September 23, 1897. Comprises a plurality of plates, wings attached to the latter and adapted to contact with each other in whatever position said plates may assume and means for making electrical connections to said wings.

Telephones :—

APPARATUS FOR STATING TIME AND NUMBER OF TELEPHONIC CONVERSATIONS. E. Kosanke, C. Fuhr and B. Krausse, Wilmersdorf, Germany, 597,003. Filed July 5, 1895. Employs a clock work mechanism adapted to be wound and released by the circuit closing and interrupting movements of the lever in the calling and speaking circuits.

TELEPHONE EXCHANGE SYSTEM. W. W. Dean, St. Louis, Mo., 597,052. Filed September 22, 1897. Provides automatic means jointly controlled by the operators and subscribers for including the calling generators in circuit with the signal receivers of the called stations.

TELEPHONE EXCHANGE SYSTEM. William W. Dean, St. Louis, Mo., 597,053. Filed September 22, 1897. Similar to above.

TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 597,054. Filed September 22, 1897. Similar to above.

CALLING DEVICE FOR TELEPHONE EXCHANGES. A. E. Keith and J. C. Erickson, Chicago, Ill., 597,062. Filed Aug. 20, 1896. Comprises a circuit breaker, a circuit changer for directing the current over different lines, a series of finger-holds, and a stop for automatically limiting the number of times that the changer may be operated.

TELEPHONE ATTACHMENT. P. J. Bose, Bremen, Germany, 597,213. Filed November 16, 1896. Adjustable device for holding telephone receivers.

THE STOCK MARKET

Improving Industrial Conditions.

When it is stated that general business shows an improvement of 10 per cent. above that of the corresponding period in the booming year of 1892, no further explanation is required of the strength of the stock market, a firmness that so far Cuban scares and political vagaries have done little to weaken. During the week 12,620 shares of Western Union were sold, closing at 90¼; 8,585 shares of General Electric around 35¼, and 758 shares of Bell telephone around 270. Among local lighting stocks, New York Edison distinguished itself by going up to 135, a record figure we believe for a security that grows more and more in favor.

REPORTS OF COMPANIES

Erie Telephone Company's Bonds.

E. C. Stanwood & Company, of Boston, have been offering for sale at 97 and accrued interest $1,000,000 of Erie Telegraph and Telephone Company 5 per cent. collateral trust sinking fund gold bonds, due July 1, 1926, being part of $2,000,000, of which $1,000,000 have been previously sold. Both the bonds and stock of the company are quoted at the New York Stock Exchange. The Erie Telegraph and Telephone Company in conjunction with the American Bell Telephone Company own and operate the subordinate corporations conducting the Bell telephone business in Cleveland, O., and in all of Minnesota, North and South Dakota, Texas and Arkansas, excepting only Duluth and the Black Hills district. The company have a capital stock of $4,800,000 upon which dividends have been paid continuously for 14 years. The issue of the bonds is to provide the Erie Company with capital for extensions of their system. The net income of the company for 1897 was $365,000, being more than double the amount of its total bonded interest.

CLOOS ELECTRIC ENGINEERING COMPANY has been formed at Milwaukee, Wis., by Jacob Cloos, H. R. King and E. A. Wurster, with a capital stock of $20,000.

METROPOLITAN ELECTRIC CONSTRUCTION COMPANY has been formed in this city with a capital stock of $50,000, by E. C. Platt, A. B. Chandler, E. H. Johnson, W. B. MacQuesten and others.

THE COLONIAL ELECTRIC CO., of New York, has been incorporated to furnish light, heat and power by means of electricity in Greater New York. The capital stock is $25,000, and the directors for the first year are: Garrett S. Odell and Orion H. Cheney, of New York, and Horace S. Andrews of Brooklyn.

TRADE NOTES & NOVELTIES

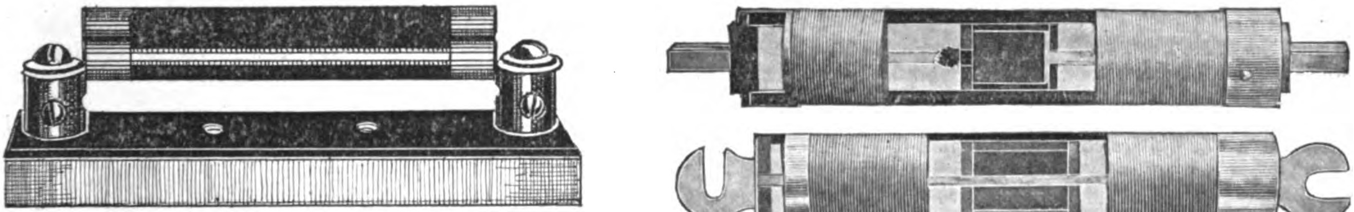
The Armington & Sims Company.

WE are glad to be able to announce the completion of the work for the full reorganization of the Armington & Sims' engine interests. For some time past steps to this end have been taken in Providence, and the results are most satisfactory, we understand, to all concerned. The new corporation is to be known as the Armington & Sims Company, and a number of well known men have become its officers. Mr. Julius Palmer, the president, is also president of the old National Bank, Providence; Mr. J. C. Church, secretary and treasurer, is a prominent business man in that city. The general manager, Mr. Fred. N. Bushnell, has been identified with the engine business for many years. For the last five years he has acted as the mechanical engineer for a number of large electrical interests, notably the Narragansett Electric Lighting Company.

It is gratifying to know that the new company starts out under the most favorable conditions, also, in the financial sense, having a capital of $150,000. It has already a number of orders for its 1898 pattern of engine, and is prepared to furnish promptly plans and specifications for engines of all sizes and for all purposes, including large direct-connected units, side-crank, high, medium and slow speed, etc. The company has an illustrated pamphlet now in press, "A Few Facts About Armington & Sims' Engines," which will shortly be ready, and which it will be glad to send to any one interested, particularly prospective customers.

The Cartwright Enclosed Air-tight Fuses.

THE Cartwright enclosed air-tight fuses are manufactured by the Shawmut Fuse Wire Company, of Boston, under license from the Goodhart Electric Company. In this instrument the fuse is so constructed that the wire melts within the central section of the tube and the heated air and gases formed thereby, forcing themselves to the outer or end sections, blow out the arc. This fuse can be used on any pressure less than 2200 volts. It will not maintain an arc between its terminals when short-circuited on the mains of a 2200-volt composite alternating dynamo.



FIGS. 1, 2 and 3.—THE CARTWRIGHT ENCLOSED FUSE.

The cutout consists of two parts; the base and tube. The base is made of the best quality of Monson slate, the tube is made of black or gray fiber. Fig. 1 represents the cutout complete. Fig. 2 represents the fuse with the central part of the case cut away to show the fuse-wire in the central air space and also the filling at each end. Fig 3 represents a 50-ampere fuse cut open after it had been short-circuited on a 500-volt circuit of 450-kilowatt capacity and it opened the circuit without noise or flash.

Owing to the peculiar construction of this enclosed safety fuse, a tube or case three inches long will open the circuit where the ordinary devices require more than twice that length operated under the same conditions and with a fuse of the same carrying capacity.

This fuse has a definite length, cannot come in contact with any foreign substances, and it will open the circuit in a pre-determined time on a given current in amperes.

Each fuse is marked the number of amperes it will carry indefinitely; it will melt on a 25 per cent. increase of current.

Porcelain Lined Outlet Boxes.

The porcelain lined outlet box has taken its place among the necessities of modern high grade interior wiring. It has sprung into prominence so rapidly that outside of the Metropolitan district it has not as yet seen much use, but thousands of these porcelain lined outlet boxes are going into the new buildings in New York City every month, and there are upwards of 100,000 already in use in that city alone. The Ward-Leonard Electric Company, who first gave these devices commercial prominence, are just issuing a 40-page catalogue, gotten up with their usual skill in catalogue work, and it is most astonishing to see the hundreds of different styles of outlet boxes, switch boxes, floor boxes, receptacle boxes, etc., which they list and illustrate both by scale drawing and half-tones.

The price of these porcelain lined boxes is now but a few cents in advance of the cost of the cast iron in the box, while the price of the first porcelain lined boxes used by C. O. Mailloux at Biltmore was about a dollar per box.

The Ward-Leonard Company have a capacity for turning out 3,000 of these boxes per day, and have by improved process so reduced the cost, that there is no longer any excuse for using the boxes having merely white paint as the insulation.

This new catalogue of the Ward-Leonard Company is the work of many months, and it is so complete and specific that it will prove a great assistance to the architects, consulting engineers and contractors in planning and executing interior conduit wiring.

Three Calendars.

THE NATIONAL CARBON COMPANY'S calendar is one that must prove very useful to the central station managers, as it bears on each of the twelve date slips the moonlight schedule for the respective months and it also gives the time of the sun's rising and setting. It is tastefully gotten up and on it appears an engraving showing the company's extensive works in Cleveland, Ohio.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., have distributed a very neatly engraved calendar on which are reproduced one of their ironclad panelboards and several styles of their split steel junction boxes. Split steel wall outlet and switch boxes have for some time been this company's specialty and they are to be congratulated on the ever-increasing popularity of their products.

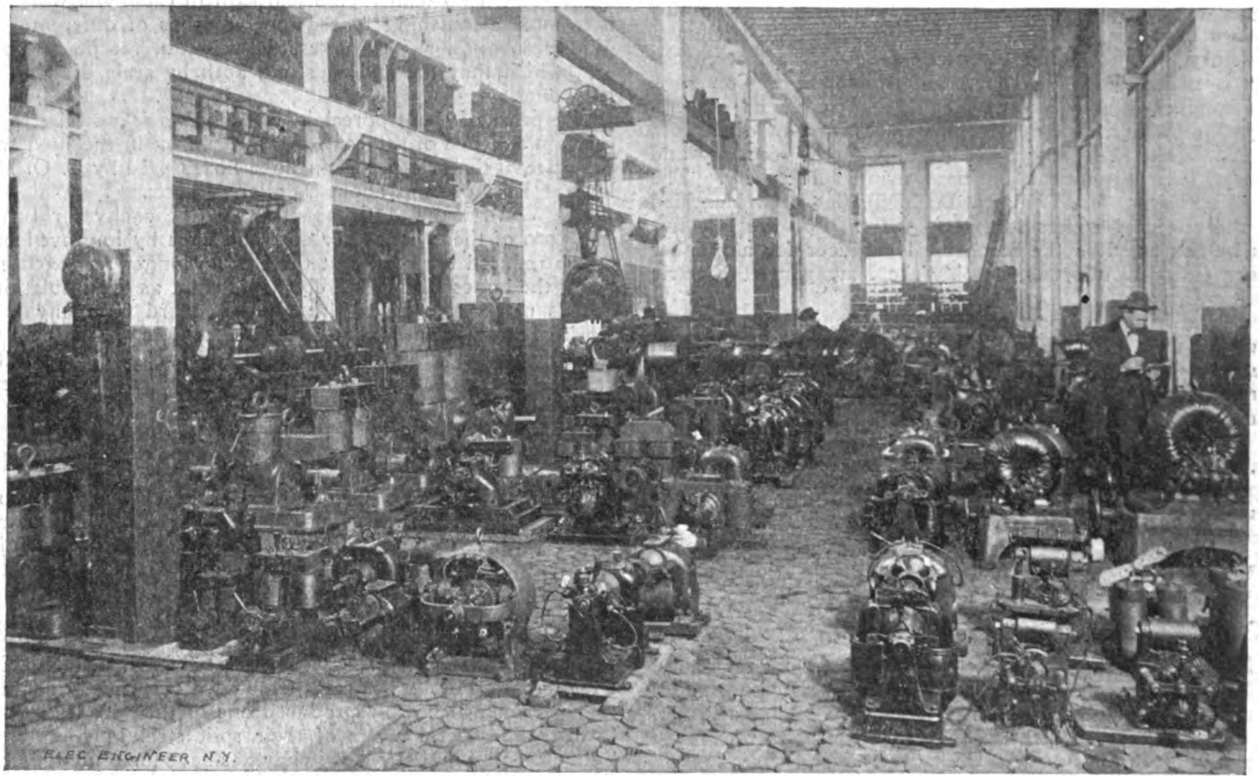
GENERAL ELECTRIC COMPANY have issued an extremely useful calendar with moonlight schedule. It is a good thing to have around the station.

ARMORITE INTERIOR CONDUIT is now, its makers assert, generally recognized by architects and contractors as the standard for all high grade interior work. This conduit, as it is now made, with the light steel wall and light lining is superior to the old style heavy conduit and is displacing entirely the old type of tubing. The Electric Appliance Co. are carrying a large stock of light wall steel armorite in Chicago and are doing a handsome business in it.

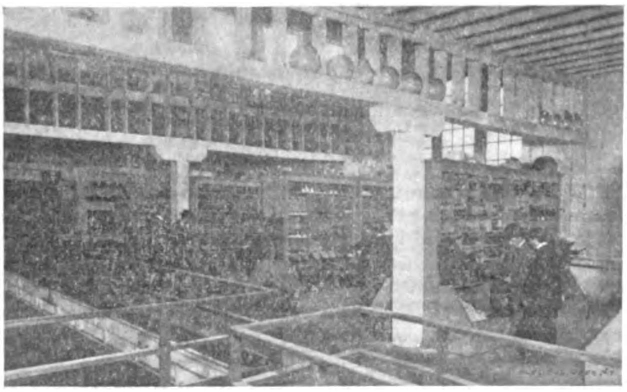
THE AMERICAN BATTERY COMPANY'S factory on Quincy street, Chicago, was completely gutted by fire on Jan. 15. Their entire stock was destroyed, but the energy of these people has been shown by the fact that they are now established in handsome new quarters at 174 South Clinton street, Chicago, occupying the entire floor and basement and are already in shape to take care of all orders. This company's loss was partially insured.

The Growth of Second Hand Business in Electrical Machinery—Chas. E. Gregory Co.

NOTHING better illustrates the fallacy of the statement that electricity is in its infancy than the proportions assumed by the business in second-hand dynamos, motors, arc lamps, meters, transformers and all the paraphernalia that are necessary in electric light and power work. A visit to the Charles E. Gregory Company establishment at Chicago, which is one of the largest second-hand electrical supply houses in the United States, will be a revelation to one who has not kept close track of this branch of the electrical business. The importance of a second-hand house in the electrical field is great, because it affords users of electrical machinery an opportunity to dispose of their "outgrown" apparatus to advantage, and many a small lighting plant where dollars come hard is glad to get the good machinery discarded by larger plants. The Gregory house started seven years ago with two employees and a small office. It now has 37 on the pay roll and the prospect that more will soon be necessary. They are now just comfortably settled in a well fitted up machine shop building, at 58 to 62 South Clinton street, and are in shape to handle their large business to advantage. If the reader pictures to himself a lot of disreputable looking apparatus before visiting the storage floor for second-hand dynamos and motors, he is destined to receive a surprise. True, there are some dismantled machines undergoing repairs, but the bulk of the apparatus is in as neat and serviceable condition as that in a nightly operated central station. Indeed, it is by necessity the policy of an established house of this kind to let no apparatus go out that is not in good condition, as its reputation is at stake. There is, therefore, no more danger to the customer in buying second-hand than if the apparatus were just from the factory. Every machine that comes in is taken apart and overhauled, no matter how well it appears. The shops are provided with power for testing and all machines are given an actual running test before being put on the stock floor for sale. One feature that favorably impresses the visitor who is acquainted with the requirements of success with electrical apparatus is the neatness and cleanliness that everywhere prevails, and one cannot but feel that where this care prevails the apparatus must receive proper care. Besides repairing its own machinery the company does general repairing for outside concerns and has a well equipped shop, hiring good armature winders and employing the latest methods. Besides the hundreds of dynamos and motors there are in-



SALESROOM FOR SMALLER MACHINES, CHAS E. GREGORY & CO.'S ESTABLISHMENT, CHICAGO.



GALLERY AND SUPPLY DEPT., CHAS. E. GREGORY CO.

STAFF AND EMPLOYEES OF THE CHAS. E. GREGORY CO.

stock nearly a thousand arc lamps, two hundred transformers and a large number of recording meters, ammeters, voltmeters, switches and miscellaneous supplies.

The time may have been when second-hand electrical apparatus was worth only its price as junk, but that time is past. True, the Gregory Company could, if it desired, purchase plenty of apparatus that is fit for nothing but the scrap heap, but as a matter of fact it cannot afford to in view of the demand for machinery practically as good as new, such as it now sells.

The new quarters which they have occupied since Dec. 1 are excellently fitted up for the business. On the street front are a suite of offices, passing through which the visitor steps into the main shop and storage room floor, which is built on solid mother earth with cedar block paving, thus adapting it to the heaviest machinery. On this floor all heavy machinery is stored and the running tests on dynamos and motors are made. The second floor consists of a gallery which runs around half of the building. On this gallery are the armature winding and arc lamp testing departments and storage shelves for instruments, automatic rheostats, and lighter supplies. A long traveling crane running down the central open space facilitates the movement of machinery.

A CORNER OF THE REPAIR DEPARTMENT, CHAS. E. GREGORY CO.

The reasons why a second-hand concern of good reputation for fair dealing and care in the quality of apparatus sent out should prosper in the electrical field is evident. Plants are constantly being enlarged and apparatus changed to better suit the local conditions. This thrown out apparatus is usually in good shape and well fitted for service in some other plant, but it is not easy for the user of apparatus to find a customer for it, and the function of the second-hand house is to carry such goods until customers can be found.

Mr. C. E. Gregory, the founder of the concern, retired from the business several years ago. The present general manager is Mr. A. L. Kuehmstead, who has had considerable experience in practical electrical work, and is well fitted for his work by both theoretical knowledge and actual experience.

NEW YORK, N. Y.—The Non-Polarizing Dry Battery Company, of New York City, has been formed, with a capital of $200,000. The directors are: James Cruikshank, of Kingston; Charles E. Becker, of Stamford; Charles N. Brizse, Walter McDougall, John C. Kaempfer, and Jacob Biebes, of New York City.

ADVERTISERS' HINTS

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., state that while all reputable engines of the present day regulate fairly well, they do not all give good economy through their full range of power. They offer to furnish data regarding the economy of the Westinghouse engine through a wide range of load.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, say that the positions occupied by their specialties may well be termed "Seats of the Mighty."

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., advertise theatre dimmers of which they always carry a complete assortment.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, illustrate their series enclosed arc lamp. It is highly ornamental in appearance and they are meeting with ready success in introducing this style as with others.

THE BALL ENGINE COMPANY, Erie, Pa., say that after an honorable and successful past their name is a guarantee of the excellence of their engines.

WM. T. PRINGLE & CO., 1026 Filbert street, Philadelphia, Pa., warn users against imitations of the Chapman patent attachment plug which they alone manufacture.

THE JANDUS ELECTRIC COMPANY, Cuyahoga building, Cleveland, O., claim that a half inch of carbon will burn 150 hours in a Jaudus arc lamp. They now offer new designs covering every branch of arc lighting.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, remind the public that they are headquarters for wires, cables, conduits, conduit tools, fittings, electrical apparatus and supplies.

I. P. FRINK, 551 Pearl street, New York, illustrates two of his many styles of reflectors adapted to any and all classes of work.

DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., are now ready for the 1898 season with fans of new and standard makes of the ceiling desk and bracket types.

THE ELECTRIC EXHIBITION COMPANY, state that more space has already been sold than the total sold at the 1896 exhibition. It will be a great show.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., publish a little chapter of definitions. One of the words defined is "Westinghouse," which means a guarantee.

THE KEYSTONE ELECTRIC COMPANY, Erie, Pa., build street railway generators of the belted type up to 400 horse-power capacity and of the direct connected type up to 275 horse-power.

The B. and O. and Greater New York.

The Baltimore & Ohio Railroad now runs its freight trains over its own tracks into New York City. Years ago a line was built from Cranford Junction on the Jersey Central Railroad to St. George's, Staten Island, crossing the Kill von Kull on a long bridge and trestle work, and all B. & O. freight, either inbound or outbound, was handled from that point. The recent extension of the limits of New York City has made Staten Island a part of Greater New York, and the B. & O. now enjoys the distinction of being the only line from the West, except one, which has its own rails into the city of New York.

NEW YORK NOTES.

TROLLEY CARS are now running across the Brooklyn Bridge.

MR. JOSEPH KEEFE, formerly manager of the electrical department, T. N. Motley & Co., has recently associated himself with Messrs. Schiff, Jordan & Co., 232 Greenwich street, New York, and is now pushing the sale of their electric light carbons, etc.

MR. L. F. REQUA, of the Safety Insulated Wire and Cable Company, 28th street, New York, informs us that the business and orders at the present moment have grown to such proportions as to necessitate the running of their factory day and night. For this reason they have had to organize a day and night shift of workmen, busy trying to keep up in a measure with the large orders pouring in from all directions.

NEW ENGLAND NOTES

BERNSTEIN ELECTRIC COMPANY, of Boston, has made an assignment.

D. & W. FUSE COMPANY have closed their books for the year and report results as being exceedingly satisfactory. Prospects and inquiries point to a largely increased trade for 1898. Orders for their fuses are being placed from all parts of the country, and are the result of test and experience giving the D. & W. fuse the highest reputation.

NEW BRITAIN, CONN.—At the meeting of the Central Railway & Electric Co., Mr. A. M. Young was elected president. Mr. E. H. Mather was elected secretary and general manager, and Mr. F. G. Platt, treasurer. Mr. Mather has already assumed his new duties in charge of the road.

PHILADELPHIA NOTES

THE CUTTER COMPANY have just issued a new catalogue and price list of their well-known I-T-E circuit breakers, embodying all the latest types of single pole, double pole, double coil, and triple pole instruments. This will be sent upon receipt of request, either from their office, 120 Liberty street, New York, or 1112 Sansom street, Philadelphia.

SOME PITTSBURG IMPROVEMENTS.—The improvements that the Baltimore and Ohio Railroad have had under way at Pittsburg for the past 15 months have been completed with the exception of a small amount of paving between the tracks which will be done in the spring. The line now has splendid terminals at that point and sufficient trackage to handle the vast amount of business with not only economy but with celerity. The changes cost in the neighborhood of $450,000 and consist of a new yard at Glenwood, (one of Pittsburg's suburbs), a double track trestle nearly two miles in length, the changing of the line of road leading into the passenger station and the building of new freight yards near that point.

WESTERN NOTES

AMERICAN BATTERY COMPANY, whose factory at 42 West Quincy street, Chicago, was recently destroyed by fire, have established offices and new works at 174 South Clinton street, that city.

AN ELECTRICAL DEPARTMENT is recommended for Chicago by the insurance interests and is opposed by the Brotherhood of Electrical Mechanics.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. FEBRUARY 3, 1898. No. 509.

TELEPHONY AND TELEGRAPHY

The Detroit Telephone Company.

BY S. P. GRACE.

IN the face of the severe business depression that has affected almost every industry in the country for the past several years, it is encouraging to look at the wonderful development and progress of the independent telephone companies. In every corner of the States new exchanges have sprung up to rival the old company. Miles upon miles of toll lines have been built, connecting together these scattered exchanges. Toll station after toll station has been established, until now almost every cross-road boasts of its telephone.

The advantages of cheap and efficient telephone service have long been recognized by the people, and, although denied them in this country, have been fully realized in the old world, especially in Switzerland and Sweden, where as a result of the low rates everybody uses the telephone.

In the United States the largest and most powerful independent telephone company is the Detroit Telephone Company, operating in Detroit, Mich. The city of Detroit has a population of about 325,000, and being a live and hustling city, well scattered, offers special inducements for a telephone exchange.

At the outset the Detroit Telephone Company decided to furnish efficient service at moderate rates, $40 for business purposes, and $25 for residences, per year. By this means they hoped to extend the field of telephonic service, and as results showed, these expectations were well founded.

ORGANIZATION.

The Detroit Telephone Company was incorporated February 20, 1896, and has the following officers: William L. Holmes, president; Charles Flowers, vice-president; Edward H. Parker, secretary and treasurer; Thomas F. Ahern, general superintendent.

It is rare that a company is so fortunate as to secure such able and competent men to direct its affairs. President William L. Holmes is widely known as a man of clever financiering and great judgment in business affairs. Mr. Charles Flowers has long been associated with legal and business affairs, not only in Detroit, but throughout the country. Besides his connection with the Detroit Telephone Company, Mr. Flowers also holds the position of Corporation Counsel

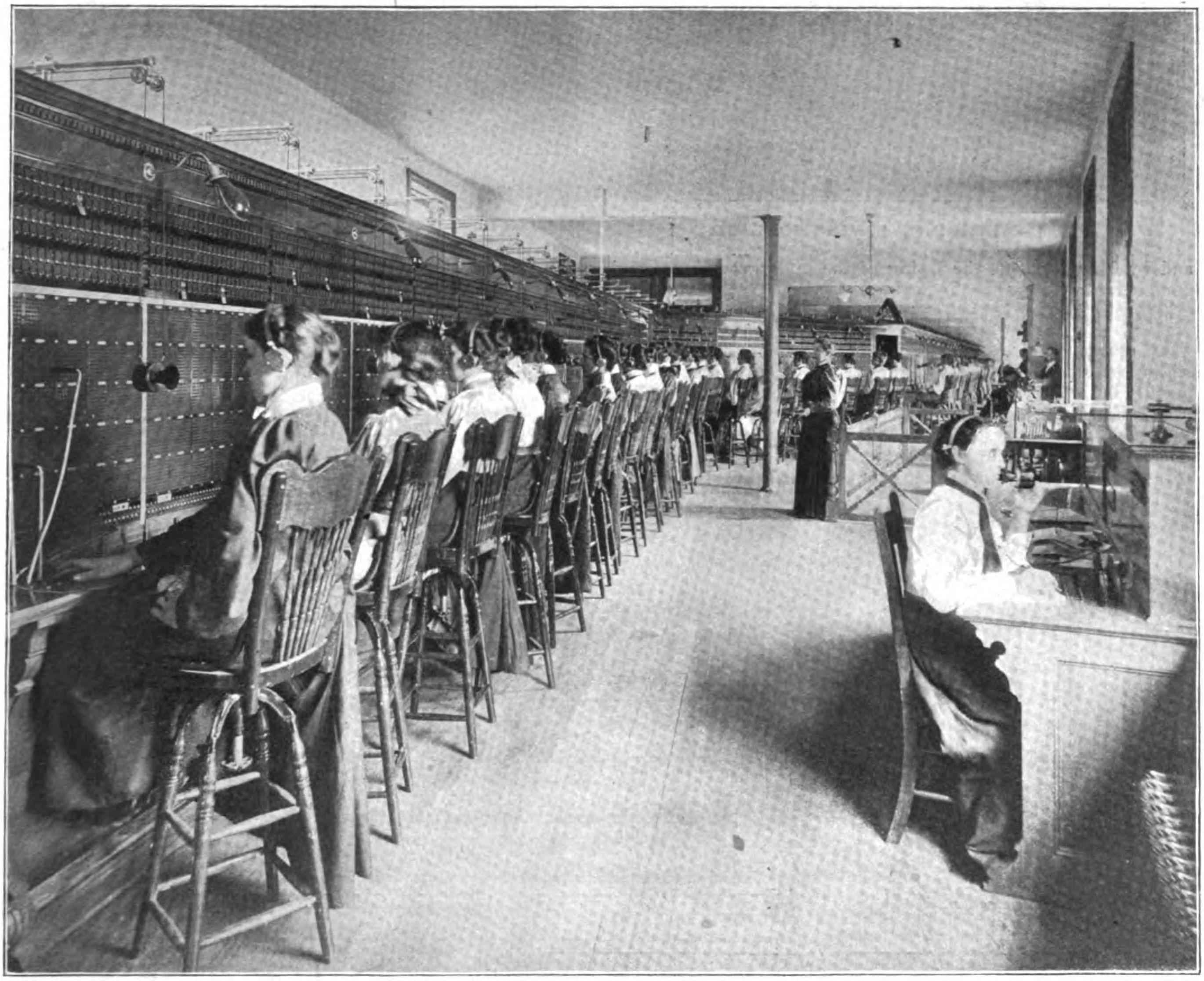

FIG. 8.—MAIN SWITCHBOARD, DETROIT TELEPHONE CO.'S EXCHANGE.
(Capacity when completed, 10,000 drops.)

of the City of Detroit. Mr. Edward H. Parker is a well known business man of Detroit and vicinity.

In choosing Mr. Ahern for the position of general superintendent, the company could not have made a wiser choice. Coupled with his seventeen years' experience with the Bell Telephone Company, is the possession of a most remarkable executive and inventive ability. Under Mr. Ahern's supervision the plans for the entire plant were rapidly developed,

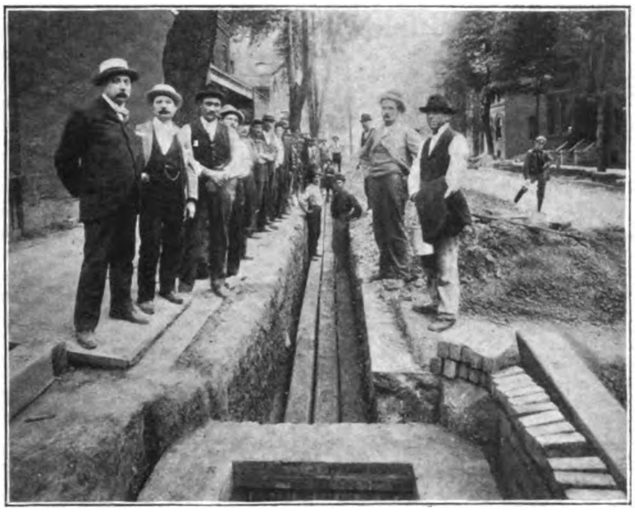

FIG. 1.—METHOD OF LAYING CONDUIT.

and by May 10, 1896, the laying of the underground conduit commenced.

UNDERGROUND CONDUIT WORK.

An ordinance of the city of Detroit provides that all wires within the half mile circle shall be placed underground, consequently in this district, and along some of the principal avenues, it was necessary to resort to underground construction. For the underground system it was decided to use multiple duct conduit. In the manufacture of the conduit the best of material is used, the result being a hard, evenly burned, salt glazed terra-cotta. The conduit is made in sizes from two to six 3-inch ducts. It comes in lengths of six feet, and, when properly laid in cement, produces a most substantial structure.

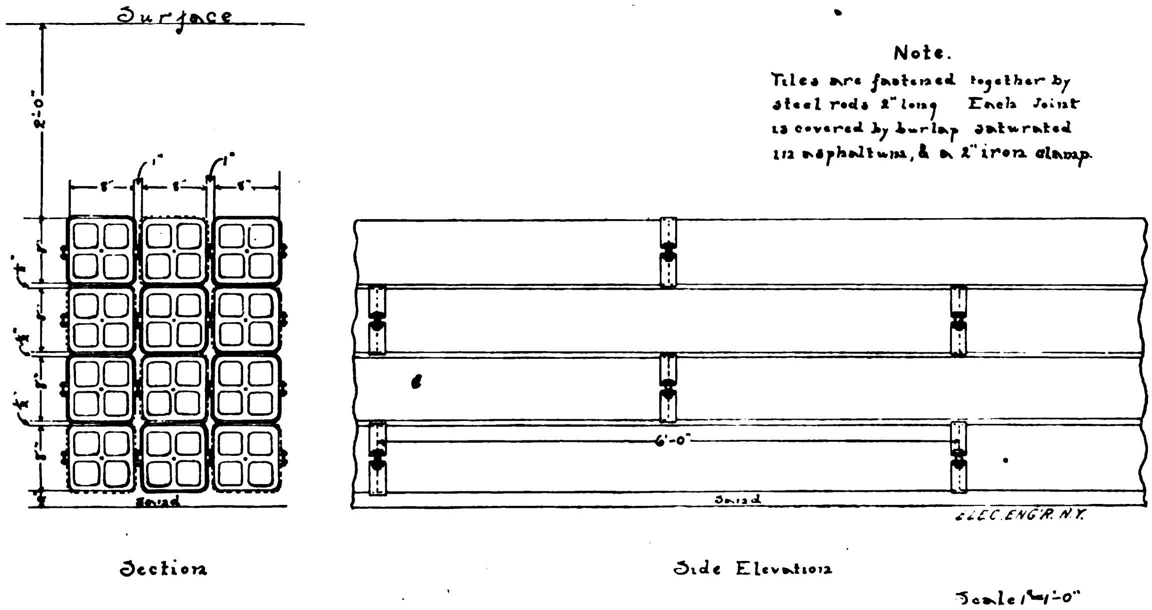

FIG. 2.—SECTIONAL VIEW OF CONDUIT SHOWING FASTENING DEVICES.

In laying this conduit the street was first excavated to a depth of three to five feet, and upon the bottom of the trench was laid a solid bed of concrete, four inches thick. After being put in place, each joint of the conduit was wrapped with a piece of heavy burlap, and afterwards sealed with cement. This made the conduit continuous and impervious to moisture. When more than one tier of conduit was laid, the joints were made to break with each other. The engraving, Fig. 1, shows the method of laying the conduit, and in Fig. 2 is shown a sectional view of the conduit.

One noticeable feature in the laying of the conduit was the fact that ample provision was made for future extension. This has always been a weak point with companies laying underground conduit, as either on account of the extra expense involved, or perhaps from lack of foresight, sufficient provision for future extension is rarely made, a consequence of which has been the continual tearing up of the streets of some of our large cities.

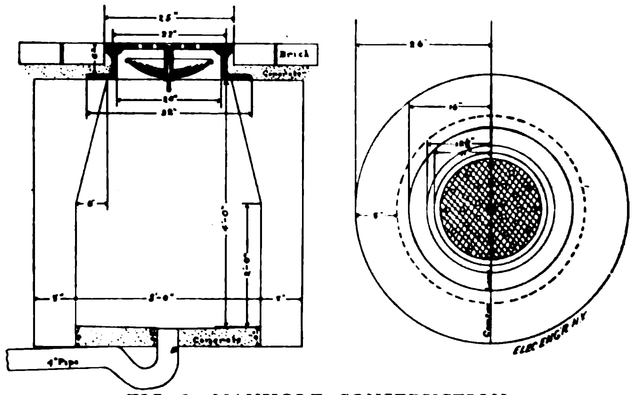

FIG. 3.—MANHOLE CONSTRUCTION.

MANHOLE CONSTRUCTION.

At all intersections and corners ample sized manholes are provided. The manholes, one of which is shown in Fig. 3, vary all the way in size from the large special, near the central office to the small type known as class D, used only for single 10-pair cables. It will be seen that the manholes are substantially constructed, of good quality, hard burned brick, laid in the best Portland cement. In the smaller sizes the sides are corbeled to receive the top casting; while in the larger sizes it rests on T-irons. Each manhole is provided at the bottom with a four-inch outlet to the sewer.

CABLE WORK.

From the terminal room, which is shown in Fig. 4, 100 pairs of cables extend through the subway into the ducts to the special manhole one-half block from central. From this point the

cables radiate in all directions to their respective points of distribution.

These cables were manufactured by the Standard Underground Cable Company, of Pittsburg, Pa., and embody the latest principles in cable design. They are made up of No. 19

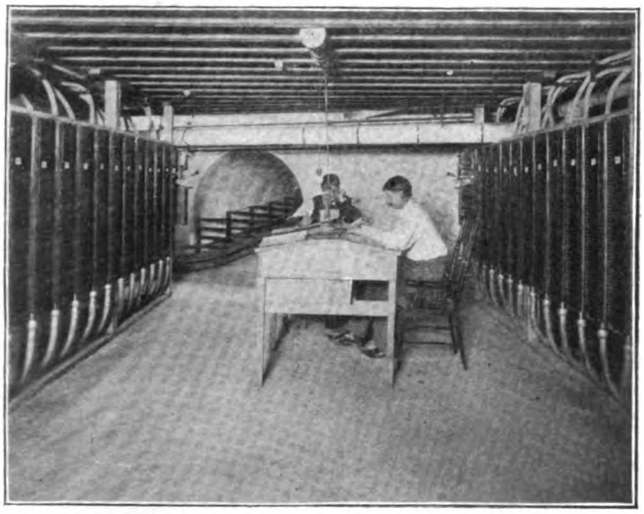

FIG. 4.—TERMINAL ROOM SHOWING SUBWAY.

paper insulated copper wires, so spiraled as to entirely prevent induction. Over all is drawn a continuous lead sheath, averaging one-eighth of an inch in thickness. One hundred and thirty miles of this cable have already been drawn in. A static capacity of not greater than .085 microfarads per mile (one wire against all others) was guaranteed and fulfilled by the

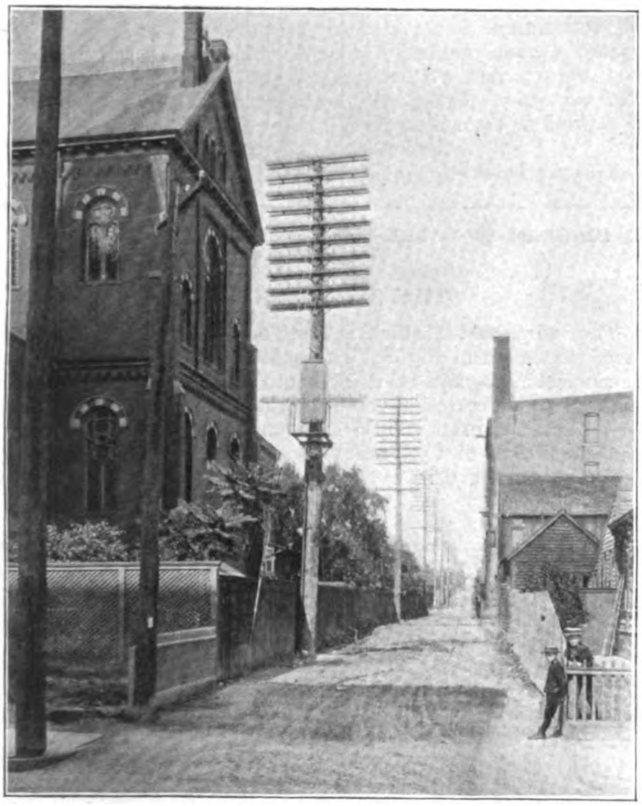

FIG. 5.—CABLE POLE WITH TERMINAL BOX.

company. All the cables are protected from electrolysis of the lead sheaths by a special system of return feeds, designed by the writer.

DISTRIBUTION OF CONDUCTORS.

The distribution in the down-town business blocks is effected by branching from the main cable a small one of 15 or 25 pairs, as required. This cable is then carried through sewer pipe to what is called an alley distribution pole, where it is run up the side of the pole in iron pipe to a terminal head, inside a specially designed weather-proof box. From the terminal head the wires are led to the insulators, and from there dropped to the different subscribers' buildings. All inside wiring is carefully done with braided duplex Okonite.

Great credit is reflected on the company's underground construction department by the fact that in all the labor of drawing in and splicing not a single wire in the one hundred miles of cable has been lost. Mr. William Collins has superintended the underground construction.

Outside the down-town district, the distribution is effected on substantially built pole lines, in the construction of which there have been used 4,500 poles, covering a distance of about 120 miles.

The main leads are designed to accommodate one hundred subscribers. At the cable pole, shown in Figs. 5 and 6, the cable from central is brought up the pole through iron pipe and distributed in a terminal box; from here tree wires run to the insu-

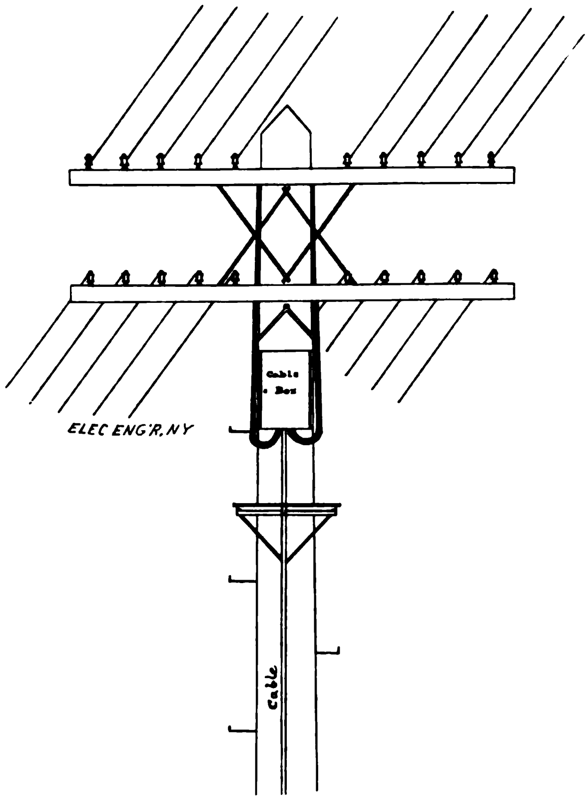

FIG. 6.—CABLE POLE SHOWING METHOD OF DISTRIBUTION.

lators, and then along the pole line to the different subscribers. Wherever centers of distribution are far removed, overhead lead cables have been carried along the pole line to these distributing points.

The outside construction has been carried out along the lines of the most modern practice. All poles are of neatly shaved Michigan live cedar, averaging fifty feet in height for the main leads, and thirty-five feet for the spur lines. The poles for the main leads, which carry from eight to ten, ten pin crossarms, are double armed, and head and side guyed with one-half inch steel strands, to anchor rods or stubs, at all corners and sharp turns. Long leads are also line guyed every one-quarter mile. Mr. W. C. Ross has superintended the outside construction, some of his careful work being shown in the engraving, Fig. 7.

THE CENTRAL EXCHANGE.

The central exchange is located at the corner of Griswold and Clifford streets in the Jones Block, a building admirably suited for a telephone exchange, because of its long flat-iron shape, which allows the switchboard to be placed in nearly a straight line. Placed upon the top floor is this mammoth switchboard, designed to accommodate 6,000 subscribers with space for 4,000 more or a total of 10,000.

Entering the switchboard room one is at once struck with

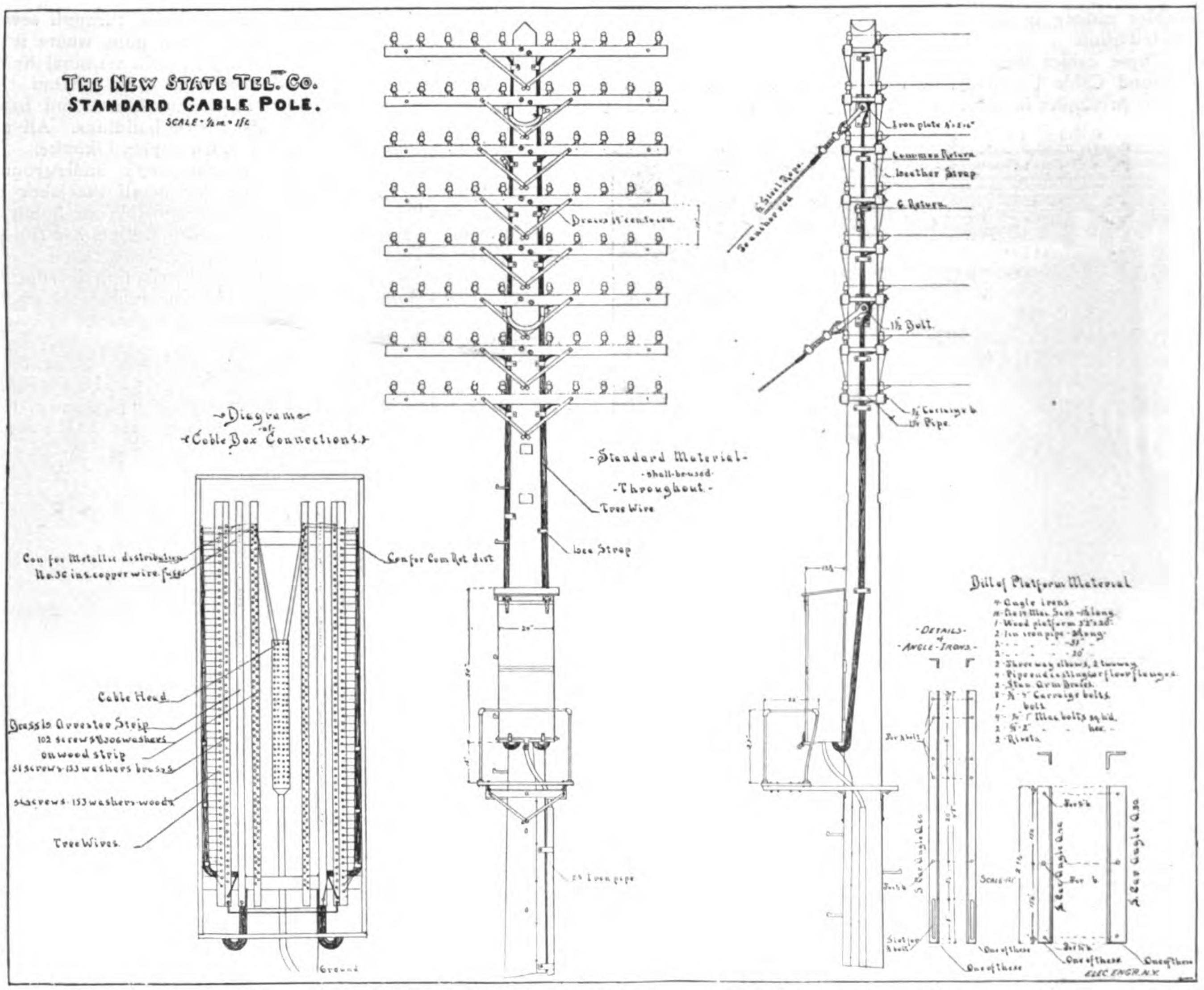

FIG. 7.—DETAILS OF POLE CONSTRUCTION AND DIAGRAM OF CABLE BOX CONNECTION.

the magnitude of the exchange, for almost as far as the eye can see, extends a line of busy girls, whose fingers make and break connections with wonderful rapidity. Noise and confusion would be expected amidst all this transaction of business, yet almost absolute quiet prevails, for the exchange work has been rapidly systematized, and the operators are thoroughly trained. It was not until Mr. Ahern attacked the problem, that quick service with a transfer system was solved. Tests on this system show an average speed of 12 seconds per connection.

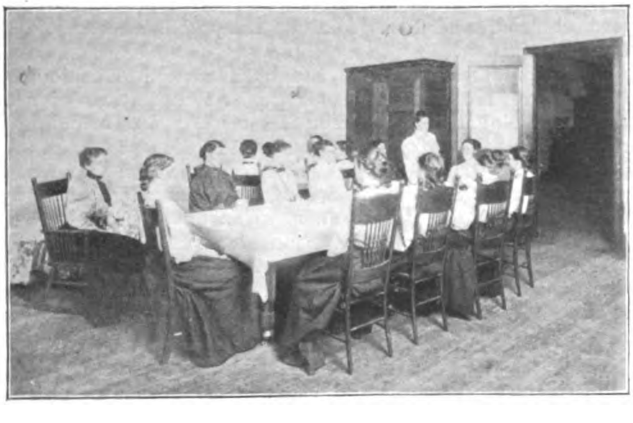

FIG. 9.—OPERATORS' DINING ROOM AT LUNCH HOUR.

THE SWITCHBOARD.

The switchboard, which is built on the "Ahern duplex system," is shown in Fig. 8. The board is 180 feet long over all, seven feet high, and is divided into 80 positions of 26 inches each. Double cotton covered wire is used for the cables, there being sixty transfer cables, each containing 200 wires, representing a total of 1,500 miles of single wire.

The switchboard as explained above is of the transfer type, connections being so arranged that any operator without leaving her position can connect with any subscriber of the six thousand. However, only a limited number of subscribers can

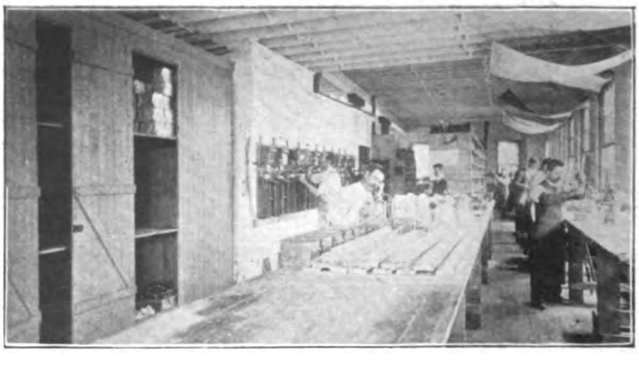

FIG. 13.—ASSEMBLING AND TESTING DEPARTMENT.

connect with a given operator, this number, as the board is at present worked, being 75.

The transfer jacks are repeated through the board at every other position, and therefore to connect with any subscriber of the six thousand, it is never necessary for the operator to reach over two feet at either side of her. The 6,000 transfer

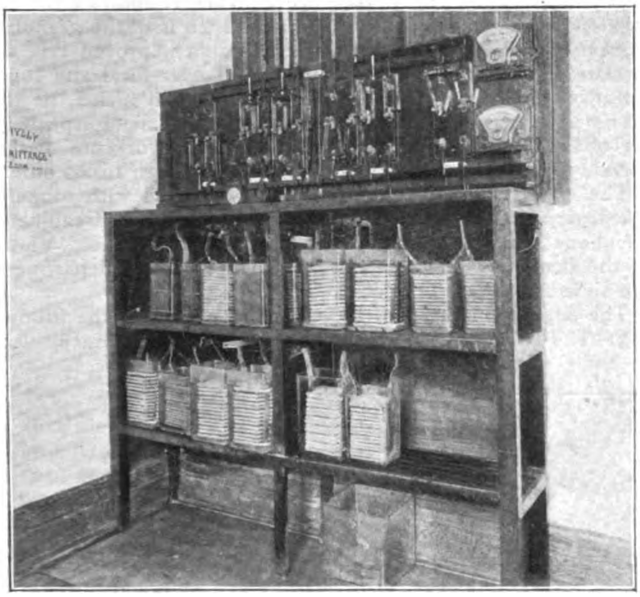

FIG. 10.—STORAGE CELLS IN POWER ROOM.

jacks are contained in a space 22 inches high by 52 inches long. All along the front of the board, and just above the keyboard, is placed a double row of 6,000 holes, behind which are the spring jacks in which the subscribers' lines terminate. Connected with the spring jacks are the annunciator drops, whose shutters fall and disclose a number when a subscriber rings in. These shutters are restored by a lever under control of the operator. Arranged in rows parallel with the front of the board, is a double row of plugs connected to flexible cords for connecting subscribers' lines together.

Fifteen pairs of plugs and cords are provided for each posi-

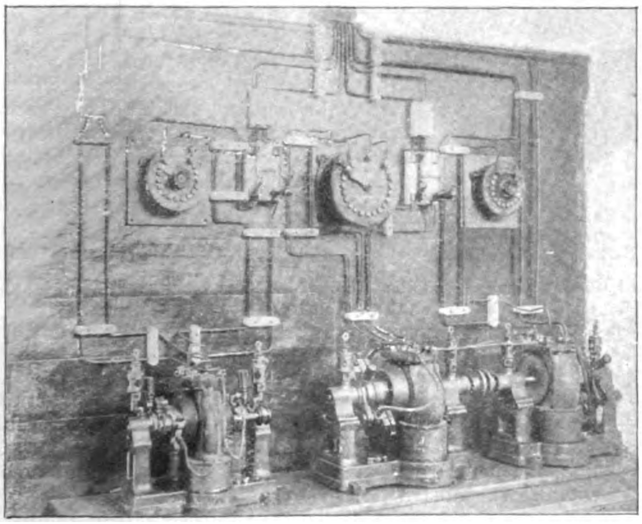

FIG. 11.—MOTOR GENERATORS IN POWER ROOM.
(Crocker-Wheeler Motor Generators for Charging Storage Batteries.)

tion. Directly in front of each pair of plugs and cords, are two buttons, one connected to the head telephone for listening, the other connected with the generator for ringing. Each operator is provided with a flexibly suspended transmitter and a receiver held against her ear by means of a head band. Metallic circuits are used throughout the board.

For the operation of the switchboard, day and night service, there are required at present 112 girls, which number will be increased to 170 when the board is completed. Every effort is made for the comfort and healthfulness of the operators, as it is fully realized that efficient service cannot be obtained from

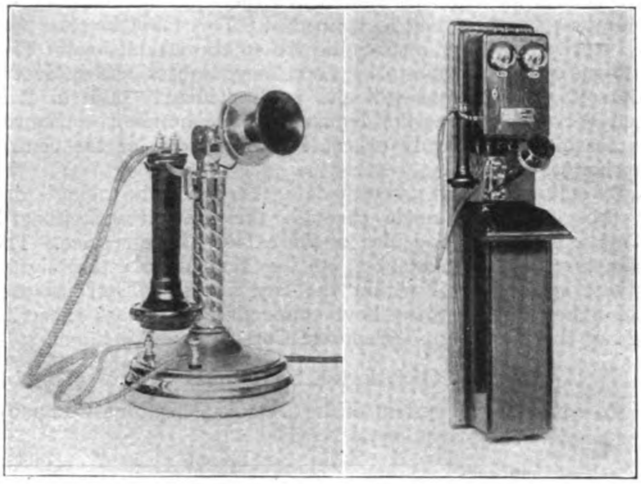

FIG. 12.—DESK AND WALL TYPES OF INSTRUMENT.

overworked operators in unventilated rooms. Back of the switchboard room is located the lunch room, a large and well ventilated room in charge of a matron. Here tea, coffee and cakes are furnished gratis to the girls at lunch hours. A

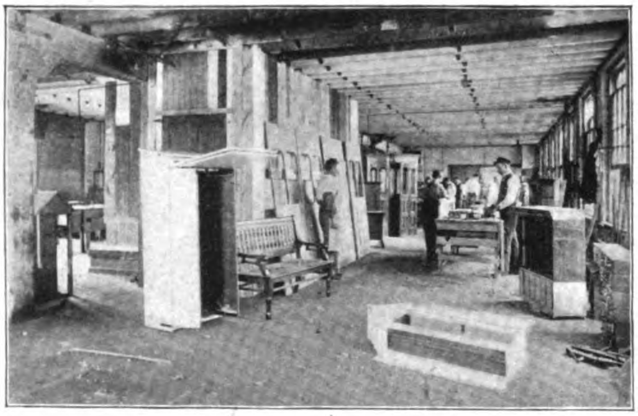

FIG. 14.—THE CABINET MAKING DEPARTMENT.

group of the girls just sitting down to luncheon is shown in Fig. 9.

Current is supplied to the transmitters and other circuits by

FIG. 15.—OFFICES OF THE ENGINEERING DEPARTMENT.

storage batteries, charged from the Edison mains by means of a motor generator. The engravings, Figs. 10 and 11, illustrate the power room, showing batteries, motor generators and

alternating ringing generator. Mr. C. L. Zahm is manager of the operating room.

At the present time there are 4,767 subscribers working on the central switchboard, and it is expected that inside of six months 1,500 more will be connected. This rapid increase was a surprise to the company, and led to the establishment of a sub-station to accommodate 1,000 more subscribers in North Detroit. Sub-stations will also be immediately built in East and West Detroit, as the demand for telephones is constantly increasing, and already overtaxes the capacity of the central exchange.

By actual count at a recent date, there were in a single day 53,859 connections made through the Detroit switchboard. This will give a good idea of the extent of the service. The company had on January 1, no less than 6,230 actual signed 3-year contracts, all within the city limits of Detroit. Besides these the company have connection with 2,258 subscribers of the New State Telephone Company of Michigan.

TOLL LINE SERVICE.

To complete the system of the Detroit Telephone Company, and furnish toll line service, the New State Telephone Company was organized. During the past summer many miles of copper metallic toll lines have been built. These radiate in all directions, and make connections with nearly 100 exchanges and toll stations owned by the New State Telephone Company. This provision of toll service is a vital point, and it is one in which a great many independent companies have been weak.

MANUFACTURING FACILITIES AND INSTRUMENTS.

The Detroit Telephone Company is also unique in the fact that it is intimately connected with a manufacturing company. This company, called the Detroit Switchboard and Telephone Construction Company, manufactures all the instruments, switchboards, drops, jacks, coils, etc., required by the Detroit Telephone Company and the New State Telephone Company. Up to the present time it has taken the entire output to supply the two local companies, but it is the intention of the company to enter the market this year and compete for outside business.

A word might be said about the instruments manufactured by this company for the Detroit Telephone Company and the New State Telephone Company. The wall set, Fig. 12, is of neatly finished quartered oak, with nickel trimmings on all exposed metal parts. The transmitter, which is of the granular carbon type, is worked with two cells of an improved type of Leclanché battery, and talks equally well over local and long distance lines. The desk set, Fig. 12, is a full nickel, neatly designed instrument, and has met with great demand especially for offices. Both these instruments for local work are of the series type, with generator wound to ring through 10,000 ohms.

The cabinet department is also well equipped with modern machinery and turns out all the booths, switchboard cabinets, telephone boxes, etc., required by the local companies. Views of the instrument department, and of the cabinet department are shown in Figs. 13 and 14.

The engineering staff of the company comprises the following: T. F. Ahern, general superintendent; S. P. Grace, electrical engineer; W. C. Ross, superintendent of construction; William Collins, superintendent of underground and cable construction; E. E. Given, superintendent of equipment; F. G. Roberts, mechanical engineer; Chas. L. Zahm, superintendent of switchboard construction.

A glimpse of the offices of the engineering department is shown in Fig. 15, and the portraits of the staff are shown in Fig. 16.

In conclusion it is well to call attention to the remarkably short space of time in which this exchange was built. Eighteen months ago not a single piece of conduit was laid, not a single wire strung. To-day there exist 30 miles of underground conduit, 120 miles of pole lines, two large switchboards, and a factory well equipped for telephone construction.

Equally vigorous has been the progress of the State Company. Fifteen hundred miles of toll lines, 35 exchanges, and 75 toll stations are the work of a single summer. Certainly this is rare progress.

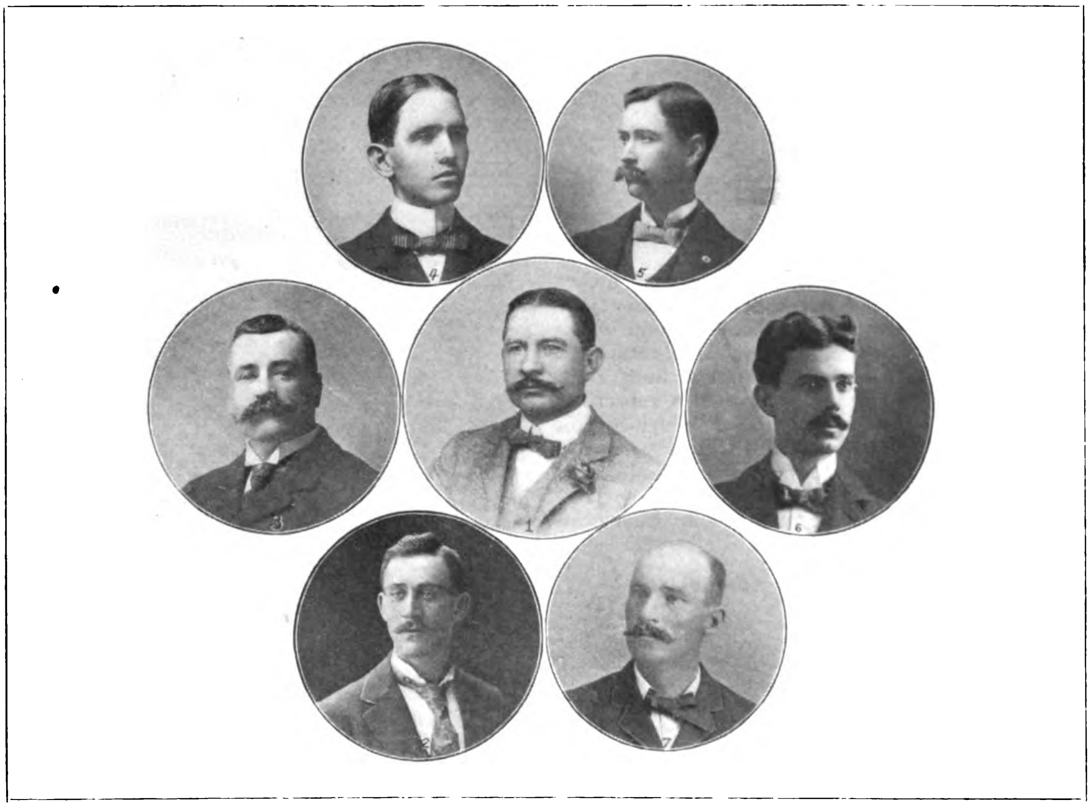

FIG. 16.—THE ENGINEERING STAFF.

1. T. F. Ahern, Gen'l Superintendent. 2. Chas. L. Zahm, Supt. of Switchboard Construction. 3. William Collins, Supt. of Underground and Cable Construction. 4. S. P. Grace, Electrical Engineer. 5. E. E. Given, Supt. of Equipment. 6. T. G. Roberts, Mechanical Engineer. 7. W. C. Ross, Superintendent of Construction.

Tests of the Synchronograph On the Telegraph Lines of the British Government.[1]

BY A. C. CREHORE AND G. O. SQUIER.

IN April, 1897, a paper[2] was read before the American Institute of Electrical Engineers, describing the general principles of the synchronograph and the experiments at that time completed in developing it. As stated therein, the next step desirable was to test the system upon long telegraph lines having considerable distributed capacity, the length of the only line used up to that time being thirteen miles. Since then opportunity has been presented to make these trials on actual lines of considerable lengths and having different distributed capacities. Through the courtesy of Mr. W. H. Preece, Engineer-in-Chief of the British Postal System, every facility has been afforded for conducting the experiments on the telegraph lines of the British Government.

The tests were made over loops of varying lenghts from the General Post Office, London, where both transmitters and receivers were located. The longest loop tried was 1,097 miles in length, from London to Glasgow, Aberdeen, Edinburgh, and return to London by a different pole line. This contained some iron wire and also 48 miles of underground cable, and a total value of K R equal to 261,000. In the course of the trials the surprising result was discovered that the synchronograph could operate the Wheatstone receiver approximately three times as fast as the Wheastone transmitter on any line, provided the mechanical limit of the receiver is not already reached.

One of the most important results of the trials to be described has been to emphasize the probability that the sine wave possesses superiority over other forms of wave for any speed, slow or fast.

The first series of tests were conducted on Sunday, August 8, 1897, over a line from London via Leeds to Newcastle-on-Tyne, and return to London via York. Over this line, with no earth, messages were received with ease at a frequency of 652 to 1,304 alternations per second.

Tests were then made over a longer line with greater K R, the route being from London via Leeds to Glasgow, and return via Edinburgh, Newcastle-on-Tyne, and York to London. As before, through this line without earth, K R being 31,771, a current was sent having a frequency as high as safety to the alternator permitted, viz., 652 complete waves per second, and no limit of speed due to the line was reached, the messages being received with perfect clearness.

The authors give curves showing the speed obtained by the Wheatstone system and show that it may be represented closely by an equation of the form K R W = a constant.

On Sunday, August 22, 1897, experiments were made over each line for speed as follows: (1) Wheatstone transmitter and receiver; (2) synchronograph and Wheatstone receiver; (3) synchronograph and chemical receiver. The results of these tests are given and the authors draw the following conclusions from the entire series of tests.

The results of the experiments described show that the use of an alternating electromotive force, which does not rise suddenly and fall off as abruptly as is the case with that of most transmitters, but which rises gradually from zero to a maximum and falls again to zero as gradually, is the best kind of wave for use on actual lines with distributed capacities.

The synchronograph, which employs this kind of an alternating electromotive force made and broken always at the neutral points, has thus far proved to be better than other transmitters for the transmission of electrical waves over a given line at any speed, slow as well as fast. An examination of the various methods employed for increasing the speed of working on submarine cables shows not only that in such methods the waves are made of equal lengths, but that an endeavor is made to compensate for the square tops of the electromotive force waves of the transmitter, which is usually accomplished by the aid of condensers or auxiliary electromotive forces judiciously arranged in shunt circuits. In other words, the attempt is made by these devices to approximate a sine wave as nearly as possible, while the remedies which can be applied by such means at best only approximate this form of wave. The synchronograph adopts a smooth wave, approaching practically the sine wave in form as its fundamental principle, and supplies a simple method of using the waves generated by an alternating dynamo.

The substitution of the synchronograph for the Wheatstone transmitter on the identical lines, using the same receiver in each instance, showed a speed of operation by the synchronograph about three-fold faster, provided the mechanical limit of the receiver was not already reached. The causes of this great increase of speed are differences in the waves which pass through the receiver; since the only way by which the identical receiver can distinguish between transmitters is by differences in the actual waves received. The waves of current passing through the receiver, which control its operation, are not of the same shape as the electromotive force waves of the transmitter. The current waves with the Wheatstone transmitter, for instance, have more or less rounded tops, but they maintain the same frequency as the transmitter, and waves for a dash are longer than for a dot. The current waves received from the synchronograph are not true sine waves in the receiver, even though the electromotive force is truly harmonic, but the frequency is the same as that of the generator and the waves are of equal lengths. The current wave from an alternator, may approximate a sine wave very closely if the electromotive force is harmonic, and in fact if there is no leakage on the line it will be truly harmonic; or under some circumstances it may still be harmonic, provided there is a correct relation between the leakage, resistance, inductance, and capacity. There are thus at least two causes which account for the slower speed with the Wheatstone transmitter, the fact that different frequencies or wave lengths are used in the transmitter and the departure from the sine form of wave.

Another cause for gain in speed by the synchronograph is the fact that higher voltage was permitted with it than with the Wheatstone transmitter, although it is difficult to estimate the precise amount of gain due to this. The reason for permitting different voltages lies in the construction of the instruments themselves; for with the synchronograph the contacts are made and broken at the zero points of the waves, and thus even when considerable capacity is present on the line, the amount of sparking is almost nil under circumstances when the Wheatstone transmitter would produce a powerful spark owing to the sudden application of the full voltage.

In view of these trials with the Wheatstone instruments it will be of interest to extend the experiments to other forms of instruments such as are now used or proposed for cable or automatic working. The gain in speed expected is less than with the Wheatstone system, since in long cables the transmitters used already employ waves of equal lengths.

It was interesting to observe whether a high frequency current, such as was used in these experiments, passing in a continuous loop of a thousand miles through a thickly-settled country, would cause any material disturbance in the telephone circuits of the region, but no such disturbances were reported, although orders were given for this to be noted.

It is believed that the Government control and operation of the telegraph would prove a great benefit to the people of the United States. The natural relation between this service and the general postal service requires that they should be under the same department for the most efficient and economical management.

[1]Abstract of a report to the Postmaster-General of the United States. Read before the Franklin Institute, January 19, 1898.

[2]The Synchronograph; a New Method of Rapidly Transmitting Intelligence by the Alternating Current. Electrical Engineer, Vol. XXIII., May 5, 12, 19, 1897.

A New West Indian Cable.

A submarine cable has been laid and is now open for business between Bermuda and Turks Island (in the West Indies). The cable is owned and will be operated by the Direct West India Cable Company, working in connection with the Commercial Cable and Postal Telegraph Companies. The rate from New York City to Turks Island will be fifty-six cents per word.

An Hawaiian Cable Offer.

James A. Scrymser, president of the Pacific Cable Company, appeared at Washington on January 18 before the House committee on interstate and foreign commerce to advocate a contract with the United States which, he said, he would not call a subsidy, whereby the company would transmit all official messages for $175,000 a year, for twenty years, from San Francisco to Hawaii, China, and Japan, with a proposition to extend it to Australia for $75,000 additional per year. He said that during the Venezuela trouble it had cost the Government $5,000 for one diplomatic message, and no one knew what the Govern-

ment's aggregate expense was in this connection. He said that it would take 8,000 miles of cable from San Francisco to Honolulu, and was sharply questioned by the committee as to the alleged monopolistic features of his proposition. He declared that his company was responsible, and had the experience to do what they proposed.

Public Control, Ownership or Operation of Municipal Franchises ?—V.

With Special References to Electric Lighting.*

By R. R. BOWKER.

(Vice-President and General Manager New York Edison Co.)

OTHER AMERICAN CITIES.[1]

PHILADELPHIA has a municipal water supply, started in the last century, which has long been its pride and has been considered very profitable to the city. But the figures apparently do not cover interest or depreciation on cost, which is indeterminate, one estimate being of $28,000,000. It started municipal gas works in 1841; these have steadily degenerated until they became a notorious disgrace to the city, and in November, 1897, an ordinance was passed leasing the plant to the United Gas Improvement Company for 30 years. The municipal plant supplied about 60 per cent. of the gas used, purchasing the rest from a private company at 37 cents per 1,000 cubic feet in gas holder. Last year there was manufactured about 5,000,000 thousand cubic feet, 3,000,000 of coal gas and 2,000,000 of water gas; the public lighting consumed 674,000 of this, 545,000 being for street lamps and there was "unaccounted for," 1,132,000. There were 168,644 consumers on the books of the bureau. The annual report complained bitterly of the bad condition of the system, and of the difficulty of obtaining adequate appropriations for modernizing it. The price of gas has been $1 per 1,000 cubic feet, said to be of 19 candle power, but the gas has been notoriously poor. The receipts in 1896 were $3,318,337, and a gross profit of $352,988 was reported. It is stated that $674,031 worth of gas is supplied free to the city. An accountant's report, however, shows $281,569 additional expenses, aside from interest on investment, improvement cost, etc., and he figures, including extension improvements, a net deficit for the past three years of $416,000 per year.†

Philadelphia's electric lighting companies are now for the most part consolidated in the hands of the Pennsylvania Heat, Light and Power Company, which includes the Edison system. There are in the city and suburbs 6,661 street arc lights at 30 to 37 cents per night, or $109.50 to $135.05 per year, costing the city about $800,000 yearly. The price of electric lighting in Philadelphia is on a base rate of ¾c. per 16 candle power lamp hour, somewhat, but slightly, reduced by discounts. In 1894 a Committee of Councils appointed to consider the establishment of a municipal electric plant reported strongly against the plant.

Chicago was formerly supplied with gas by nine companies with at least three sets of pipes in some streets, of which eight have been consolidated in 1897 into The People's Gas, Light and Coke Company, originally organized as the Gas Trust Company in 1887, but blocked by legal proceedings until the consolidation act of 1897. The consolidated company has a capital stock of $25,000,000, on which it pays 6 per cent. dividend, and a bonded indebtedness of $29,000,000 at 5 per cent. interest. It has about 158,000 customers, consuming over 5,000,000 thousand cubic feet; its revenue, including by-products, is above $6,000,000. The city receives 3½ per cent. on gross receipts or at least $150,000 per year exclusive of city and State taxes. The price of gas, which was $2.50 in 1883, was made in 1893 $1.25 with a reduction of five cents per year, by which the price is now $1.

In electric lighting, the Chicago Edison Company has consolidated into it eight other companies, including all except four small companies still existing on the south side. The Chicago Edison Company (Nov. 30, 1897), has 6,000 customers, with 5,500 arc and 234,000 incandescent lamps and 7,400 horse-power in motors. The smaller companies, south of Thirty-ninth street, show 2,500 customers, with 1,600 arc and 67,000 incandescent lights and but 45 horse-power in motors. Besides these there are probably 200 or 300 private plants, aggregating perhaps 8,500 arc and 200,000 incandescent lamps and 1,000 horse-power in motors. This shows a total in electric lighting of 15,700 arc and 500,000 incandescent lamps, the equivalent of 657,000 16 candle power lamps and 8,445 horse-power in motors, in all nearly 900,000 equivalent. Chicago reported, 1896, 1,624 street arc lamps, of which 459 were supplied by private companies at $102.70, 59 at $137.50 and 116 from a municipal plant at $96.76. Oil chiefly is used by the gas companies; soft factory coal costs $1 to $1.10 at riverside factories. Chicago has no general subway system, but the conductors are underground except in the suburbs. The subway legislation requires that for new grants the consent of property holders shall be required for new subways as for new street railways.

Boston has been supplied with gas by the Boston and the Bay State Companies in the city proper and by five local companies in its suburban districts. All the Boston interests have been consolidated (Dec. 1897) in the New England Coke & Gas Company, with $17,000,000 stock and with $17,000,000 bonds. The two chief companies have paid 10 and 9 per cent. dividend on capital of $4,500,000. The price of gas in Boston is now $1. Boston has its electric lighting chiefly from the Edison Company, with $3,750,000 capital, paying 7 per cent., and no bonds, and the Boston (high tension) Company with $1,700,000 capital, paying 6 per cent., and $1,062,000 bonds, besides which there are a suburban company of $174,400 capital, a small block plant company of $9,500 capital and 200 private plants. The Edison Company reports 1,541 arc lamps, 158,000 incandescent lamps and 6,109 horse-power in motors; the Boston Company (1896) 2,193 arc lamps, 50,629 incandescent lamps and 1,468 horse-power in motors. The city lighting is supplied by the Boston Company with 2,159 arc lamps averaging 35 cents per night or $127.75 per year. The price of incandescent lighting is 9-10c. per 16 c. p. lamp hour. base rate, with lamps, subject to discounts; the average return for 1896 was 7-10c. for incandescent lighting. All these systems are under the control of the Massachusetts Board of Gas & Electric Light Commissioners, from which permission to increase capital, extend systems and organize new companies must be obtained, to which detailed annual reports must be made, and by which a valuable annual report is issued.

Brooklyn obtains its gas supply from the Union Gas Company, a consolidation of five or more former companies. It obtains its electric lighting from the Edison Company, which has consolidated with it the Citizens (high tension) Company, and from two small companies in the Eastern district, besides private plants. A new Kings County Gas & Illuminating Company has recently been organized with a view to electric lighting. The Edison Company has a capital of $3,750,000, paying 6 per cent. dividends, and bonds of $1,000,000 paying 5 per cent. interest. The price of incandescent lighting is 1c. less discounts for average consumption, and less additional discounts for large bills, bringing the average price below ¾c. per 16 c. p. lamp hour. Brooklyn has 3,200 street arc lamps, of 1,200 nominal candle power, for the most of which it pays 34c. a night, or $124.10 per year.

Toronto, Canada, should be cited as a city which has taken over the ownership of its street railway tracks, which it rents to the Toronto Railway Company, under a carefully drawn agreement, giving the city from 8 per cent. up to 20 per cent. of gross receipts and assures reasonable fares, special tickets being sold for working men's hours at 8 for 25c., and children's tickets for school hours at 10 for 25c. Ordinary tickets are 6 for 25c., while at Kingston, with a private company, the price is 8 tickets for 25c. Two years since, the municipality proposed to establish a municipal lighting plant, but it was voted down, and the gas system is operated by the Consumers' Gas Company, and the

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the business cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

[1]Lack of sufficient and reliable data compels the omission of detailed statements concerning Detroit.

†See the articles by Dr. Frederick W. Speirs and Col. John L. Rogers for a more detailed discussion of this subject.—Editor.

electric system by the Toronto Electric Light Company. The city makes a contract for street arc lamps each four years.

Electricity in Municipal Engineering.[1]

BY PROF. R. B. OWENS.

(Dept. of Elec. Eng., Univ. of Nebraska.)

MY object in presenting this paper is to emphasize the economy which can often be effected by generating at one point all the power required by a municipality, and its distribution for whatever purposes, by electrical means.

But I am not to be understood as advocating the community ownership and operation of any interest which can be as well administered by individuals. On the contrary, I believe the vicious efforts, so noticeable of late, to shift individual responsibility to that popular misconception, "the government," marks the begining of another serious setback to the growth of democratic institutions.

However, I will not attempt a discussion of private versus municipal ownership, even the phase presented by the lighting question. I only wish to show the economy of combining the several problems in municipal engineering involving the use of power and to point out a further considerable field for the use of electrical apparatus.

The several principal problems referred to are, of course, the supply of water for potable and other uses, the disinfection and disposal of sewage, the destruction of ash bin refuse, and street lighting.

When a city is so fortunate as to be able to get good water from a nearby river or lake, with or without pumping, much that I have to say will not apply. But in the majority of cases in our flat western country water is only obtainable from wells, driven or dug, and when a considerable amount is required, as for municipal uses, it is generally necessary to separate the wells as far as practicable, because of the limit to the supply which can be continuously obtained per unit of volume of water-bearing strata.

In small towns of a few thousand inhabitants, where the underflow is good, it is usual to find driven wells ten to twenty feet apart and a direct-acting steam pump over each, an arrangement, which, as a rule, requires the construction of a railway siding for rapid coal supply. In larger towns of from fifty to sixty thousand inhabitants and upwards, it is not unusual to find half a dozen pumping stations from one-half to one mile apart, each with a full complement of boilers, steam pumps, and attendants, and the whole operated apparently as much in the interest of the coal dealers and those on the pay roll, as for the taxpayers. A one or two cylinder pump without fly wheel, lifting from a single dug well and discharging directly into the mains, is usual.

In a case of this kind recently coming to my notice, I urged the immediate substitution for the steam pumps of an equal number of triplex power pumps operated by constant torque variable speed motors, the current for such motors to come from a central power plant equipped with economical machinery and suitably located.

The annual saving as the result of such a change was estimated to be more thatn fifty per cent. of the total cost of operation. It might be remarked here that the recent appearance of satisfactory constant torque motors, in both alternating current and direct current types for operation from constant potential circuits, removes the last difficulty in the most general application of electric power, and now it can be confidently hoped that non-expansive steam-working, as in boiler feed pumps, drain pumps, etc., in our lighting and power plants and also in many cases of pumping from wells against a constant head for city and other supply, will soon become a thing of the past.

The usual method of handling sewage is by means of a water carriage system draining into the nearest stream without disinfecting. But this practice is barbarous. No system of sewage is complete which does not abstract the solid matter and sterilize the liquid portion before turning into our waterways.

Chemical methods of sewage disinfection, when effective, are expensive, and it would seem that electrical methods must supercede them in the future. The two principal methods of manufacturing a disinfecting fluid by electricity are Hermite's and Woolf's, the former being used principally on the continent and the latter in this country. They do not differ much except in detail. In both systems the disinfectant is obtained by passing a large current of electricity at low pressure through sea or salt water, prior to, or after being mixed with the sewage. From this results the formation of certain hypochlorites, hypobromites and iodine compounds, which latter are for the most part in the form of iodates, all strong oxidizing agents, directly or indirectly.

One installation of the Woolf system reported, consists of a 15 horse-power engine with suitable dynamo, tanks, etc. A bacteriological examination made by competent persons showed almost perfect sterilization. This plant is considered sufficient for disinfecting the sewage of 30,000 population if run continuously.

At usual rates for fuel and attendance, the cost per inhabitant per annum was shown to be about twenty-five cents. A similar cost per inhabitant has been obtained elsewhere. It will be seen, however, that this figure can be reduced to a small fraction of itself if the system were operated as a part of a combined plant instead of as a small separate one. As compared with other systems of sewage purification, chemical, land filtration, or a combination of chemical and land systems, the cost per inhabitant per year by the electrical system, even when current is supplied from a special plant, is apparently less by from one-half to two-thirds.

Another important point to note in this connection is that the electrical system while cheaper and in general more effective, requires power at practically a uniform rate, a condition fitting in very perfectly with the economic operation of a pumping plant and the requirements of a plant to burn and utilize town refuse.

The matter of disposal of ash bin or more generally town refuse, has not received the attention it deserves. There is but one successful method of handling it, and that is, to burn it; but town refuse has a calorific value equal to about one-fifth that of ordinary coal and consequently may become with proper arrangements for its burning a source of profit instead of an expense.

A difficulty in utilizing the heat energy of town refuse for street lighting is that it requires to be burned at a very regular rate the twenty-four hours. To meet this, the so-called thermal system of energy storage has been devised, but since the power required for pumping, supposing some reservoir capacity in the water system, and for the electrical purification of sewage, is in many cases practically constant and more than that obtainable from the refuse, a combination plant would save the expense of such a thermal system and accomplish as much.

It is seen then that a destructor plant will combine very perfectly with a plant to supply current for sewage disinfection and for pumping.

For street lighting electricity need only be considered, as the demand for electric illumination, as against other means, is almost universal. But the peculiarity of municipal lighting as compared with ordinary commercial lighting is the constant power required while lights are in use, a feature which again lends itself happily to combination with a pumping plant and plant for sewage disinfection. Also in many cases it will be found that the amount of power required for lighting is not far different from the amount required for pumping. Now from what has been said, it will be evident that in many cases a combined plant can be designed to burn and utilize the ash bin refuse, do the pumping of water from a series of scattered wells, and supply current for street lighting and sewage disinfection, in which all the machinery will be loaded very nearly to full capacity, twenty-four hours a day.

The extremely uneconomical machinery used for pumping in many places to-day, and the demand for better sanitation, offers, it seems to me, a very considerable further field for electrical machinery and one which I trust will not long remain uncultivated.

[1] Read before Northwestern Electrical Association. Abstract.

WILLIAM DINWIDDIE, the eminent photographer of Washington, who has been taking a series, both scenic and industrial, for the Baltimore and Ohio Railroad, has completed the outdoor work and is now engaged in making proofs of the eight hundred or more negatives that he secured during the summer and fall. About one-third of this work has been completed, and photographic experts, who have examined it, pronounce it the finest collection of its kind that has ever been taken. One of Mr. Dinwiddie's scenic B. & O. views has received honorable mention in the Salon at the Carnegie photographic exhibit in Pittsburg.

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Exploded Examples.

THIS is peculiarly an age of investigation when every fact and every theory has to prove itself worthy of renewed confidence and acceptance or be dismissed into the limbo of exploded, fraudulent fables. The habit of inquiry has so fastened itself upon our times as to have become almost a disease, except in France, where they still have a robust cowboy way of lynching a man and considering it an outrage on the community if he dares afterward try to establish his innocence. It seems to us that the "prove all things" method is the best. Once in a while, the world may lose a beautiful dream, but the gain in solid truth counts for something as an offset.

We have thus ourselves in a modest way been trying to get at the facts in regard to municipal lighting plants, the data about which only too often appears to be in the nature of that upon which Col. Sellers based his imaginary wealth. We get tired of hearing about the greed and grasp of private corporations when one after another they are driven to the wall of bankruptcy by low prices. We become rather sceptical about the purity of municipal plants when every instance that is probed shows either a state of corruption not previously suspected or else sees the figures of cost run up so high that one wonders how the original estimates could ever have secured the credence of any intelligent community. At this moment we are publishing the able review of the municipal plant question by Mr. R. R. Bowker, of whose public spirit so many proofs have been given to the citizens of New York. It will be followed by the counter arguments of Prof. John R. Commons, whom it is a pity to anticipate; but since he quotes ancient and fishy data when more modern instances abound, we must once more venture into the fray.

Two of the standard municipal plant examples are Batavia and Dunkirk, in this State. Chicago was once a brilliant case to cite, but with prices up around $175, is not so frequently cited. Detroit is later, but with costs somewhere between $100 and $110, is not so much in favor. But for years past little Batavia and modest Dunkirk have been quoted and are still cherished by Profs. Commons and Frank Parsons. It so happens that Mr. Horatio A. Foster, who made our inquiry in 1894, was recently called in as an expert at Tonawanda, N. Y., where the local company, under favoring conditions, was offering 170 arc lights at a round figure of $78.35 per year, or $.0195 per lamp per hour, rather than sustain the competition of a new municipal plant. Mr. Foster was, therefore, commissioned to look into these wonderful instances of Batavia, Dunkirk and Jamestown, in this State—and found just what might have been expected. He found that in Batavia, on any proper, scientific basis of bookkeeping the cost per lamp per hour was $.0204. In Dunkirk it was $.0251, and in Jamestown it was $.0217. The plant in Dunkirk is in bad shape, changes are being made on the plant and an addition of $10,000 will be necessary to the city's investment.

Nor is this all. Mr. Foster says of Jamestown: "Although the Jamestown plant is kept in most excellent condition as regards the station itself, I am told by the best authorities that lamps are often out for a long period, and in the case of two lamps they were said to have been out for upwards of four weeks. I am told that it is not infrequently the case that a whole circuit will be out for some length of time during the evening. Of course this being a city plant, there is practically little growling about the results, but it is needless to say that if the street lamps were in the hands of a private company such delinquency would be very vigorously brought to the attention of the company by notices in the local papers and growls from individuals. Personally, I am of the opinion that Jamestown would be considered better off if its plant were leased to an individual corporation and a definite sum per light paid by the city."

This reminds one of the recent remark from Detroit that one great argument for a municipal plant was its superiority in respect to "outages." Evidently that argument "cuts no ice" at Jamestown.

Mr. Foster goes on to point out that the service offered by the Tonawanda Company is below the cost of that of several municipal plants in New England, according to the careful returns of that trustworthy body, the Gas and Electric Light Commissioners of Massachusetts. The figures of cost per arc lamp per hour show up as follows:

Braintree, municipal	$.0455
Danvers, municipal	.0329
Marblehead, municipal	.0239
Middleborough, municipal	.0400
Peabody, municipal	.0220
Reading, municipal	.0553
Wakefield, municipal	.0752
Tonawanda, N. Y., private	.0195

In conclusion we may note Mr. Foster's estimate of a cost of $200 to $250 per lamp installed, for a street lighting plant at this time; an amount very different from that upon which municipalities are invited to make the plunge into a new business enterprise.

Englewood and Chicago Electric Storage Battery Road.

EVER since the consolidation of storage battery interests in this country, electrical engineers have looked forward with a feeling of satisfaction and vindication to the time when the storage battery would displace the uncomely overhead and expensive underground trolley. The problems, which had up to that time occupied the minds of a few investigators, were now being attacked by numerous inventors desirous of producing a light weight accumulator, one which would not deteriorate rapidly, and a generally practical system of handling storage roads.

While these questions received the closest attention of electrical engineers, the steam generating and transmitting, as well as electrical machinery, were being marvelously developed. But while we heard of storage batteries performing many useful functions in central stations, the only roads, worthy of mention, whose cars were equipped with accumulators, were those of Berlin, Paris, Vienna and Birmingham. On the other hand, the Metropolitan Railway Company of New York, after a thorough investigation of all existing methods of street car propulsion, adopted the electric conduit system over a large network of thoroughfares.

We have watched, meantime, in conjunction with everyone interested in electric traction, ever since its inception in 1895, the progress and success of the Englewood and Chicago electric storage battery road, and now, that the results of carefully executed efficiency tests have been made available, we take pleasure in presenting below some of the results and conclusions of these tests to our readers. During last summer over twenty motor cars were operated, often with trailers, and thousands of

people were carried each day. The tests were conducted under actual operating conditions, no effort being made to obtain results better than might be expected in every day service. The engines developed a total of 232.72 horse-power; the electrical output was 186.9 horse-power, showing an efficiency of 80 per cent., the average all-day efficiency being 79.3 per cent. The log of the boiler tests shows that the steam pressure was 168.3 pounds, and that 8.22 pounds of water were evaporated per pound of combustible from and at 212 degs. F., and that the boilers developed 149 horse-power each; 62.86 per cent. of the total calorific power of the fuel was utilized. The results of the tests on engines, dynamos and auxiliaries show that 18 pounds of dry steam were used by each engine per indicated horse-power hour. The average output of each generator was 128.3 kilowatt, which was 67.5 per cent. of full load. The load factor was .82, and the watt hours per pound of coal 155.2. The cost of coal was $1.90 per ton, and its cost per net kilowatt hour .611 of a cent. The conditions of the test were not favorable, however, as the steam pressure was lower than it should have been and the vacuum was only 24.25 inches. The engines were also overloaded during the entire run and were not operated at their rated speed. The average percentage between the horse-power developed in the cylinders and the electrical horse-power delivered on the switchboard is shown to be 79.27 per cent., which is very satisfactory, and the efficiency of the generators (running 32 per cent. below their rated capacity) is 93.1 per cent. The total station efficiency from coal pile to switchboard is 5.58 per cent. As a matter of comparison we may state that the efficiency of the Chicago Edison Company's Harrison street station, producing electrical energy for .3 of a cent per kilowatt hour, is only 4.61 per cent.

To make a fair test of the batteries, 110 trips were made on one day and 123 trips on another, giving a total of nearly 3,500 car miles. The results of these tests show the following:

Kilowatt hours at switchboard per car mile, 1.37 and 1.63 for the two days, respectively; pounds of coal per car mile, 9.45 and 10.50; cost of coal per net kilowatt hour, .655 and .611 of a cent; cost of coal per car mile, .897 and .966 of a cent. It should be remarked that there was a coating of ice upon the rails during the latter part of the second day. The total number of stops during four trips was 57, and the average speed of the cars was 11.84 miles per hour. Two efficiency tests of the battery give results of 53.6 per cent. and 62.32 per cent., respectively. These results, however, show the efficiency in actual service, but do not represent the possibilities of the batteries. All these results have been arefully plotted in the form of curves, including acceleration and current curves.

While the figures given above are very gratifying, it should be stated that the tests do not demonstrate the best results that may be expected of storage battery traction and were not made for that purpose. The primary object of the test was to determine where improvements could be made, and if this is kept in mind when comparing the results with those obtained on a trolley system of about the same size, it will be seen that the cost of fuel for accumulator traction of something less than one cent per car mile is very favorable to storage battery traction. After the improvements suggested by the tests have been made, and better coal than was used on the test, at a cheaper price, has been secured, the fuel cost per car mile should be brought well within one-half cent. The batteries have operated from eight to fourteen thousand miles and are standing the service remarkably well, so that the maintenance account up to the present has been comparatively small.

The tests were in charge of Mr. George A. Damon, consulting engineer, who was ably assisted by Prof. T. P. Gaylord and a corps of students from the Armour Institute of Chicago. In conclusion we venture to express the opinion that the experience gained by the enterprising Englewood and Chicago Street Railroad Company will benefit all interested and engaged in electric street railway development, and that it will lead to further improvements in accumulators, and the more extensive introduction of storage battery traction in the United States.

Independent Telephony.

THE fortunes of "independent telephony" have been checkered up to date and bid fair to continue so in many respects and in many places. But the matter would certainly wear a different aspect if every new opposition plant, outside the Bell circle, were to present the admirable work and organization of the Detroit Telephone Company, as now illustrated and described fully, for the first time, in these pages. We are sure the article will surprise and impress many of our readers by its details of excellent engineering; but only a visit to the plant can disclose the full excellence of the staff, the work and the equipment. We have our own doubts as to the advisability of the low rates at which the Detroit company is giving its service; having known something of the reconstruction period in the Bell business all over the country; but we must bear witness to the ability with which this opposition exchange is carried on in Detroit and to the satisfaction which the citizens have so far derived from it. To say that it is creditable to all concerned is but doing it the barest justice. There are other independent exchanges in the country making fine reports. If the general average of excellence were that revealed in Detroit, the telephone situation would be the most interesting one in the whole field of electrical industry.

An Interesting Electric Railway Anniversary.

THE pace is rapid in electrical development. To-day, February 3, ten years ago, saw the start of the Sprague electric road at Richmond, Va., an event which may be truly said to mark the beginning of the commercial development of electric traction by modern methods in this country. There had been a great deal of good work done before that time both in Europe and this country, and a great many of the fundamental principles of successtul operation had already been determined or put in practice. The work of such men as Short, Field, Daft, Henry and Van Depoele in this country particularly had made a deep impress on the art and is still there in living characters. But while inventive development had gone on so rapidly here, there had come a time when the "industry" had to take shape; a "psychological moment" when some things were to be rejetced forever and others were to prove their vital fitness; an hour when capital could be attracted or again repelled for a long period, perhaps indefinitely. Mr. Sprague launched his memorable Richmond enterprise at this critical hour, and with the help of such men as E. H. Johnson, O. T. Crosby and S. D. Greene he won signally. The Richmond road was a great stride in advance; a dating point; and though it was far from perfect, capital at once recognized in its methods and in its 30 cars the actual realization of the successful, modern street railway system. To-day that system with its 15,000 miles of road and $1,500,000,000 of investment can look back over the long way it has come since Thomas Davenport first tried his little model sixty years ago, but it will now and always find the victory at Richmond one of the shining landmarks in its history.

Multi-Voltage Dynamos.

ON another page we give a description of a method perfected by Mr. S. W. Rushmore of working ordinary direct-current multipolar generators, whereby a simple machine with single commutator may be made to deliver its entire output over a single circuit in the usual way, or be instantly connected to a number of independent circuits and the voltage on each circuit independently varied from zero to maximum without the least mutual interference. The circuits may be arranged to fulfill the conditions of a feeder and main system, or one circuit may carry a lamp load while another carries a variable elevator load without the slightest interference between the two. In connection with a set of storage batteries the load on the engine may be steadied and the boosters and wasteful resistances be done away with. The system devised by Mr. Rushmore embodies principles which heretofore have not been thoroughly understood and we expect further developments in their application.

WITH reference to the Sprague motor suspension patent decision noted in our columns last week, it would seem that its scope and present value are thrown very much in doubt by those against whom the litigation has been in reality directed. A brief discussion of the points at issue, from the Walker Company, will be found in our legal notes this week, seeking to clear up the misconception which they think may possibly exist in the public mind on the subject.

ELECTRIC LIGHTING

The Practice of Theory.[1]

BY J. C. McMYNN.

THE subject of this short paper reminds me of a trolley car, for the reason that it can be turned either way and runs equally well. Whether the subject should be the "Practice of Theory" or the "Theory of Practice," I must leave for your judgment.

In the development of electrical machinery, together with the necessary steam auxiliaries, theory and practice have been the complements of each other, and neither could have reached the present stage of perfection without the assistance of the other. Theory is much more progressive, and as a usual thing precedes practice, for practice paves the way, and lays the track, and makes it possible for the practical man to become a factor in the engineering profession.

The object of this paper is neither to praise nor decry theory or practice, but to simply recall to your minds the close relations existing between the theoretical man and the practical engineer; to a certain extent we are all theorists, for we have our own original ideas and fancies, and oftentimes the engineer who prides himself on being a practical man, is the most theoretical.

In my idea the application of theory to practical work is of the utmost importance to every owner of steam and electrical machinery. In construction work as well as in operation, it is most valuable. I firmly believe, after mature observation, that the educated engineer who can master practice as well as theory, is the one who will rise above his competitors in the future. Yet, do not understand that by "educated" I mean necessarily a college graduate. A man who can master the laws of mechanics, and can conquer mathematics by his own exertions, is deserving of more credit than one who was sent to college and learned simply because it was pounded into him.

Nearly every modern machine is an example of practical application of mechanics and design to theoretical ideas and discoveries, which thus become mechanical laws. In a certain way, theory is the foundation and practice the structure of an engineer's attainments. The deeper and more substantial the foundation, the higher and more imposing can be the superstructure; the more substantial the foundation, the more resistance will the structure have, to either the winds of adversity or the more dangerous gusts of flattery and adulation.

The Present Efficiency of Incandescent Lamps.[1]

BY JOHN E. RANDALL.

THE present efficiency of incandescent lamps for central stations lies somewhere between 3 watts per candle power and 3¾ watts per candle power. At the Detroit meeting of the National Electric Light Association, in 1887, a 1½ watt lamp was described. Every investigation of claims for extremely high efficiency has shown that there was some hocus-pocus; either the candle was of the wax taper variety, or the watt was not one of the family that James made famous, or else the lamps didn't live to tell the tale.

Finally the people forgot about the 1 watt and the 2 watt lamp, and concluded to take what they could get, which might be anything from 3 watts to 5 watts, depending upon what the maker had ready to send. It really was a matter of small moment whether the lamps were 3 or 5 watts per candle since they all went to 5 watts the next day after they were placed in circuit.

This state of affairs has continued, with some improvement, until a comparatively recent date. It was found by authentic tests that lamps whose initial efficiency was less than 3 watts per candle power would not last a reasonable time on commercial circuits. This set the maximum limit of efficiency. The minimum was set by what the people would accept and it was placed at 4 watts. More recently all energies have been exerted to produce types suitable for the various kinds of uses. We have now the highly efficient central station lamp, the isolated plant lamp, and the railway type, besides numberless modifications for special uses.

Among the lamps in the Franklin Institute tests was one Weston tamadine —16 that maintained its brilliancy and gave most excellent life. Since then the cellulose filament has been brought to a degree of perfection far surpassing the prototype. While made by a process differing from Mr. Weston's the present filaments possess all the good features to be found in this early lamp and have outgrown most of the poor ones. Upon the quality of this cellulose filament I base a claim that the present efficiency of incandescent lamps is better than it ever has been, and is so much better that the lighting industry is to be congratulated.

The incandescent lamp is still a filament of carbon of high resistance hermetically sealed into an exhausted glass globe, with conducting wires passing through the glass. Its quality as an illuminant depends directly upon the quality of the filament and the quality of the vacuum. The object of the vacuum is three-fold: 1. To reduce the energy expended, per unit of light emitted; because of the heat lost through convection. 2. To prevent injury to, and destruction of, the carbon by burning. 3. To prevent injury by abrasion or so-called "air washing."

When the vacuum reaches 1 part in 1,000, the loss of heat by convection of the gas becomes extremely small and, after a vacuum of 1 part in 10,000 is reached, the loss is negligible, so far as our present methods of measuring light can determine. Some years ago we made a series of measurements showing the relation between the degree of vacuum and the power necessary to produce a definite candle power from a lamp filament. The net results showed that, so far as the convection losses are concerned, the degree of exhaustion ordinarily found in incandescent lamps is better than need be.

We would naturally suppose that the residual gas was composed of oxygen and nitrogen, in the proportions found in air. The induction coil shows that such is not the case, and I believe that in a properly exhausted lamp, although no other gas may be purposely admitted to displace it, no oxygen remains. It is known that a filament will rapidly decline in brilliancy if the vacuum is low, because the radiating surface is injured, but it will not burn out. Very few lamps burn out because of poor vacuum, unless cracked, when, of course, fresh oxygen is constantly admitted.

While the effects of abrasion formerly were considered of importance, my experience indicates that, at present at least, they are of small consequence. A high degree of exhaustion, as measured by a vacuum gauge, is not the object to be attained; an unchanging vacuum is essential to the maintenance of the highest brilliancy. In the type of lamp made five years ago a positive injury resulted if the vacuum were made too high. The disintergration of the filament, due to evaporation of carbon, not only injured its surface but seriously darkened the bulb.

The vacuum does not grow poorer with age, provided the lamp is properly made and exhausted in the first place. Many think that all lamps gradually lose their vacuum. This mistaken notion was caused, no doubt, by a fault common to many individual lamps having the old form of seal at the base, and illustrates the influence which apparently unimportant details exert upon quality, as well as the necessity for wide information and extended experience in successfully making lamps. The present lamps, made by modern methods, have perfect joints, or else the leaks are so bad as to be instantly discovered by proper inspection.

The filament is the most important element of the lamp, so far as efficiency is concerned. Filaments are now made from a form of cellulose, reduced chemically to an amorphous state. The quality of the filament is determined by the thread. The process of squirting threads is controllable if proper skill, experience and appliances are employed.

In purity, density, surface polish and uniformity, the features that determine quality and maintain efficiency, the cellulose filament, properly made, far excels any other kind. A graphitic coating covering an amorphous carbon body, in a vacuum, is, so far as known, the best combination for fulfilling these conditions. The science of lamp making consists in knowing how the carbon body can be formed, how the graphitic coating can be given and how the vacuum can be produced. The art of lamp making consists in doing these things perfectly and uniformly a thousand times over every day. Whenever lamps are found to be uniform in voltage and efficiency they are found to

[1]Read before the Northwestern Electrical Association. Abstract.

be good. In all their minor features, recently made lamps are superior to those of older dates.

Another point worthy of consideration is the evolution of types suitable for the different conditions of service; one for close regulation and central stations, one for poorer regulation and isolated plants in general, one for street railways and other purposes in which, for certain reasons, the service is severe. Added to these are the almost innumerable varieties for special uses, such as window decorations and signs. Finally the use of cellulose has made the 220 volt lamp a commercial possibility.

It may be claimed that the new lamps are more delicate than the older bamboo, in that they cannot be run as long before the filament will break. I am not willing to admit that the cellulose filament is more delicate, either in transit or in service. Under identical conditions, it will live longer than any other form of filament. Furthermore, the individual life approaches nearer the average than has been the case with any other material. Any carbon filament which will not maintain its brilliancy should live to a good old age.

The best proofs of any claim are those based upon actual performance. In support of the claim that the present efficiency of incandescent lamps is more satisfactory than the past, I submit some comparisons.

In the subjoined table are results of tests made upon three classes of lamps: 1st, the 110 volt cellulose; 2nd, the 110 volt untreated bamboo; 3rd, the 50 volt treated bamboo, the initial watts per candle power were nearly 3.2 for all. The bamboo represent their class, both the 110 volt and the 50 volt having been carefully selected. The tests upon these were a part of a series upon a large number started in groups of various initial watts per candle, and their results are consistent with those of the entire test. The tests were carefully conducted with the best facilities. They may be considered reliable. Both lamps were at one time extensively used and well regarded.

The figures shown for the cellulose lamps are the combined results of a number of tests made at various times and places and by different persons but evidently made under similar conditions so far as regulation is concerned. There is excellent agreement, not only in averages but in individual cases, both in candle power and in watts per candle power. The oldest tests which were made over three years ago, show the poorest results. This fact suggests a gradual improvement in the quality of the cellulose lamp. All the lamps entering the tests were samples of commercial lamps taken at random from large lots. No claim is made that the results are remarkable. I believe that they can be relied upon to represent faithfully the present efficiency of the incandescent lamps supplied for central station use.

AVERAGE C. P. AND W. PER C. P. OF BAMBOO AND CELLULOSE LAMPS DURING VARIOUS LENGTHS OF BURNING.

During a Run of		0 Hrs.	100 Hrs.	200 Hrs.	300 Hrs.	400 Hrs.	500 Hrs.	600 Hrs.	700 Hrs
Av. C. P.	Cellulose, volts 110	16.	15.89	15.86	15.68	15.41	15.17	14.96	14.74
	Bamboo, volts 110	16.	14.1	12.9	11 8	11.0	10.4	9.9	9.6
	Bamboo, volts 50.	16.	15.8	15.3	15.0	14.6	14 2	14 0	13.7
Av. W. / C. P.	Cellulose, volts 110	3.16	3.26	3.13	3.37	3.53	3.51	3.54	3.74
	Bamboo, volts 110	3.20	3.50	3.80	4.08	4.32	4.53	4.75	4.90
	Bamboo, volts 50.	3.20	3.28	3.37	3.45	3.53	3.61	3.67	3.76

The remarkable feature is the close agreement between various lots made at widely different times. This feature is the criterion of quality. Upon it depends the successful introduction and use of the highly efficient lamp. I believe that they can be relied upon to represent faithfully the present efficiency of the incandescent lamps supplied for central station use, because every result was used in the table, whether good, poor or indifferent. This table shows the mean candle power during a certain period of service, and not the value found at the end of the period. In the Columbia factory the accuracy of rating is considered a matter of prime importance and constant effort is made to keep the standards exact. Each lamp has a mark whereby its history may be known. The volts at which it gives its normal revolving horizontal candle power together with the current passing are marked upon a suitable label. A record of these items for each lamp is made at the same time upon a sheet. These sheets are the indices of uniformity in the product.

One of the largest alternating stations in the country has, by substituting the highly efficient cellulose lamp for the low economy silk and bamboo and by improving its regulation, been able not only to reduce the price of service to its customers, but to increase its lamp capacity over 25 per cent.

There is still one condition to be fulfilled in order that incandescent lighting may be more profitable, the voltage at the lamps must be kept everlastingly and unceasingly steady. There has been improvement, but much more is possible and desirable. Everything about lighting service is improved where regulation is improved, even the customer's temper.

Electric Lighting For Profit.[1]—I.

BY ALEX. DOW.

I SUBMIT as the first proposition that we are all in business to make a profit. I don't expect to be contradicted on that proposition, although some may wish to so amend it as to indicate that they are at present content if they can avoid a loss. As a second proposition I submit that the conditions of the electric light industry have so changed in the last few years that the opportunities of profit are limited; that the margin between earnings and expenses tends to vanish and can only be kept in view by unceasing endeavors to increase the one and reduce the other. The days have departed when a neat dividend could be paid on a small business done at high prices; and now, if a dividend is to be paid at all it must be earned by doing all the business that can be obtained and at prices set but little above the actual cost of production. As the preceding statement forms the text of this discourse I ask your attention to its repetition, as follows: I believe that the proper policy of electric light management under the conditions of the present time is to sell electric energy to every accessible user, in any shape that the user requires, and at the lowest price which will pay a reasonable profit on the capital investment.

A New Policy for New Times.—Those of you who were in the business at its beginning will recognize in this profession of faith the converse of the rule which then governed us. We used to believe in a "system," and the people who taught us to so believe, charged us so much for the experience, and the incidental machinery which we acquired, that we in turn had to collect great prices for the product sold to our customers. The rule was to get out of the business all that it would stand. Electric light was then a novelty and a luxury and a mystery, and was to be respected and paid for accordingly. Nowadays it is a thing of domestic use; the machinery for its production is sold as freely as any other machinery, the principles governing its distribution are taught to all who desire to learn; and its supply is recognized as a customary or even necessary public service exactly as is the supply of gas and water. It is proper that we should announce a policy suited to the new condition. That many have done so I know; and also that some have long been governed by just such a policy as I advocate; but there still remains, to the detriment of the business at large, some who are trying to run their affairs on the old plan. They do not profess to do so, and if challenged they may plead the old excuse—that the cost of their plant and the losses incident to its first operation have been so great as to require high prices for the energy sold. That excuse is not valid in these latter days. Taxing customers all they will stand means competition either by an opposition plant or by the municipality; and either of these means ruin to the station which is run on the old lines.

Of course I do not intimate that any member of this association is managing his business to-day after the fashion of the "eighties." But each of us knows of some plant in the next town to ours which is run just that way. That plant is going to fight it out on the old line until it is wiped out by a municipal plant; and the municipal plant will publish a report to the whole United States that it has reduced the price of lighting thirty or forty per cent. Then you and I and each of us is going to have the trouble of explaining at great length to our own particular municipal authorities why a municipal plant established in our town cannot possibly make any similar reduction.

The man who used to sell experience to us is probably to-day trying to show the ambitious city fathers of that other town next to ours how well they can serve their constituents and how much

[1]Read before Northwestern Electrical Association, Jan. 19, 1898, at Milwaukee. Abstract.

honor they can obtain from society at large by engaging their municipality in the electric lighting business. Our friend with experience to sell is not one bit more exact in his statements than he used to be long ago, and we cannot honestly say that his operations are beneficial to our business. But he is less detrimental than the man who gives him a chance to get in his work; the man who ought to be giving good service to a satisfied constituency but who is furnishing lights that are a disgrace to the "system" and its owner and trying to collect higher rates than those at which you and I are giving first-class service to our public.

What is a Reasonable Profit?—This is a much discussed question. The man in the next town believes that a reasonable profit is everything he can get; and at the other extremity of belief is the man who holds that no public service should pay a profit to any individual. Between these limits will be found the opinions of the great majority of Americans whose democratic training has taught them that the Commonwealth should not undertake any work which can be satisfactorily performed by private enterprise. Those members of this great majority who have money invested in manufacturing or in commerce recognize that a reasonable profit means something more than can be obtained by the investment of their funds in government bonds or by placing them in a savings bank; and yet something less than is hoped for when the investment is of a speculative character, involving risk of total loss of capital, such as the exploiting of a new mine or the insurance of an overdue vessel and its cargo.

I believe that after operating expenses are paid and any deterioration of the investment shown by a carefully made inventory has been made good, a dividend such as is paid by a good manufacturing business is reasonable for electric lighting. Such a dividend will necessarily vary with the line of manufacture; those concerns who manufacture a staple having a practically constant market being satisfied with a narrower margin of profit than those others where the production has to be varied from time to time and new markets developed at intervals. The same considerations govern in the electric lighting business. A station which is well established, has no ruinous competition to meet, is not threatened by municipal interference, and is not obliged to continually risk money in extensions of an uncertain character, may well pay a dividend but little in excess of the current rate of interest in savings banks. The station in which all these conditions are reversed, particularly when there is a prospect of its investment being wiped out by causes which its management cannot control, is entitled to a greater return.

There is much work to be done in the education of the public to a proper understanding of the economical principles underlying this subject. The citizen who has theories about municipal service does not apply these to his own affairs; nor will he apply to his theories the rules which govern his personal practice, until you show him that this should be done. He thinks it no harm that he should draw from the capital invested in his own business ten or fifteen or twenty per cent. in addition to a fair salary for management and any loss that is shown by annual inventory. He thinks it entirely proper that he should build up a business worth much more than its nominal capital by returning into it a large annual surplus. But he will denounce as extortionate an electric lighting company which pays a good deal less than ten per cent., and for such a company to show a surplus is in his eyes prima facie evidence of robbery of the public. He on the one hand refuses to protect the public service corporation from unlimited competition, and on the other hand demands that it do business for a rate of profit accepted only on the safest class of investment bonds.

In Europe they are more logical. They limit the price which a company may charge to its customers and the dividend which it may pay to its stockholders. They require the company to give good service to all who demand it within a certain area. But at the same time they permit no competitor to enter the same district and they provide for the purchase of the property at a reasonable price in the event of the franchise not being renewed at its term. Where they restrict they also protect. Our theorists have yet to learn that these two actions should go together and it seems to be our affair to teach them this lesson.

How Shall Rates be Made?—There has been of late much discussion of this subject at conventions and in the electrical press, and with good reason. American practice has heretofore been to make rates without sufficient analysis of cost; and particularly without attempting to make each unit of energy sold bear its proper share of the standing charges of the plant. Promising that we are to readjust rates for a minimum profit, we must do so according to a carefully considered system.

The base of any system of rate making must be analysis of the costs of production. The method of analysis which I have found most useful, is that proposed by Mr. Arthur Wright. The paper read by that gentleman at the last meeting of the National Association is doubtless familiar to you, but as American conditions usually differ from those existing at Brighton it is seldom possible to apply the short method of estimating standing and running costs which Mr. Wright found convenient, and an analysis in detail must be made. I use the following method:

Consider what the condition of the station would be if you were obliged to be ready to do the same business that you now do and during the same time, but had no customers taking current. You would have fires lighted, men on duty, dynamos turning over, lines strung and connections made to customer's premises. You would burn enough coal to keep up steam and keep the dynamos in motion, and you would have enough help for these conditions. But you would not burn so much coal as if the machinery were running at full load; and you might need less help. Your lines would be out in the weather or buried in the ground; and that deterioration which is due to time and to climate would go on just the same and would have to be made good by a repair gang. But you would not need renewals of incandescent lamps or carbons and you would not keep any men to put in fuses for customers or to read meters. You would need a manager and an engineer and an electrician just as you do now, but you would not need a bill clerk nor a collector, and you might do without an office boy. My rule is to ask whether the item of expense under consideration would continue or would cease under the conditions described. If it would continue it is a standing charge. If it would cease it is a running charge. It is clear that taxes, insurance and interest are standing charges.

Mr. Wright has shown us that it costs us a great deal of money to get ready to serve a customer, even though the customer only requires service for a single hour in a year. This amount he calls the standing charge. He has pointed out that a uniform rate takes no account of this but is apparently based on the assumption that it costs just the same to furnish current to a customer for one hour in the year as for each hour of one thousand hours in a year. He argues correctly that in making rates we should take account of a customer's load factor, and he goes on to describe an ingenious method and an ingenious device invented by himself for taking such account. Whether we adopt his device or not we must all admit the correctness of his statement of the conditions governing costs of production and we must, if we are hereafter to do business at a profit, make our rates with a due regard to these conditions.

To discuss in detail the whole theory and practice of rate making is beyond the scope of this paper. I advise each of you who has not already done so to make analysis of your costs in such manner as to distinguish between standing and running expenses. Using Mr. Wright's paper as a text book, you will find (as I did) that the labor is well paid for by the results obtained. Properly tabulated these results will show what business is profitable at any given rate or what rate should be made on any given business. My analysis showed me that I could afford to sell current to a large class of users at 4½ cents per unit, while a rate already established at 14 4-10 cents for another large class was not profitable. Now I am taking all the 4½ cent business I can find and am letting other people hunt for the 14 4-10 cent kind.

Classes of Business.—The immediate business of an electric lighting station is to supply incandescent and arc lighting, and power for stationary motors. Some small plants limit their business to lighting, and thereby avoid operating during the daylight hours. I think that this is often done without good reason. There is in nearly every village some demand for power, or such a demand can be developed by an enterprising manager. It is likely that the rates to be obtained for power will be very low, but if they will pay the additional cost of running the station during the daytime and also carry some proportion of the standing charges, these low rates may be profitable indirectly by reducing the amount of standing charges remaining to be earned by the lighting business. It is certain that interest, insurance and taxes run for twenty-four hours a day, although the plant may only operate for twelve, and if the power load will

pay half of these items, in addition to its actual running cost, it is worth having.

Some stations do not run all night. The people in the village where such a station is located may go to bed early and may not use any appreciable amount of current after 11 o'clock or midnight. But I have always found it difficult to work up a good business in residence lighting unless the plant undertook to give all night service. Apparently customers do not care to have a duplicate lighting equipment in their residences.

I am sometimes told that residence lighting is unprofitable. It surely is, if every residence that is served requires an independent transformer, and if only one residence in a dozen takes current at all. The only way to do residence lighting at a profit is to do all the lighting or nearly all that there is in a given residence district, and for this purpose the rate must be placed so that every possible customer can afford it. I have tried the experiment of low residence rates on a small scale more than once and in each instance with success. It is to be tried now on a large scale in several stations and I am certain that the experiment will be successful. The load factor of residence lighting is much better than the average load factor of many stations.

MISCELLANEOUS

The Rushmore Multi-Voltage Dynamo.

THERE has long been a demand for a large slow speed direct current generator that would deliver its output at a number of independently variable voltages, and thus meet the requirements of high generating efficiency without sacrificing the flexibility to be had where a number of smaller units are employed. Although inventors have tried for years to produce such a machine, they have heretofore met with little success and few engineers have believed that such a machine could be built that would meet the requirements of service and compete

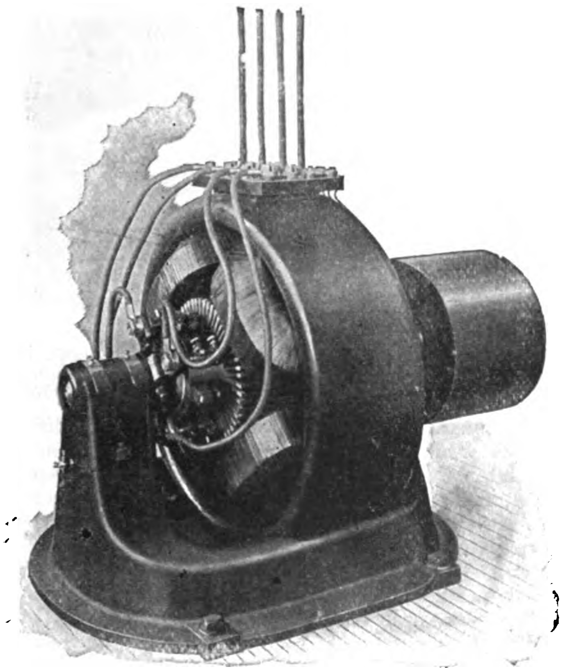


Fig. 1.—THE RUSHMORE MULTI-VOLTAGE DYNAMO.

with standard single voltage machines in first cost and efficiency of operation.

After a number of years of study and experiment, Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, N. J., has perfected a method of working ordinary multipolar generators, whereby a simple machine with single armature winding, single commutator, etc., may be made to deliver its entire output at a single voltage in the usual way, or be instantly connected to a number of independent circuits and the voltage on each circuit independently varied from 0 to maximum without the least mutual interference.

By the new method a machine will supply as many circuits as there are pairs of poles, and the voltage is varied by varying the excitation of the poles acting on the different parts of the armature. Each pair of brushes with the corresponding section of armature and pair of field poles constitute, as it were, an independent machine, and each may supply a separate circuit;

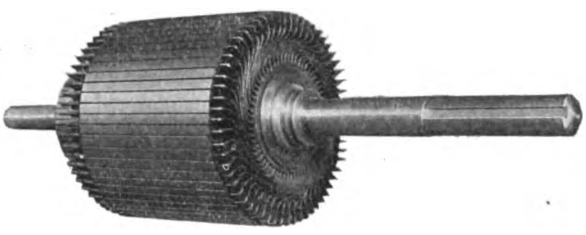


Fig. 2.

or they may be connected in groups to meet the requirements of the different circuits to be supplied.

Fig. 1 shows a 4-pole two-circuit machine now on exhibition at the Rushmore Works, and Fig. 2, the bar wound armature employed. The machine is operated in connection with a special switchboard for showing all its various applications. When brushes of the same sign are connected together on a single circuit, the machine will deliver its entire output in the usual way. To show how the machine will fulfill all the conditions of a feeder and main system, one pair of brushes

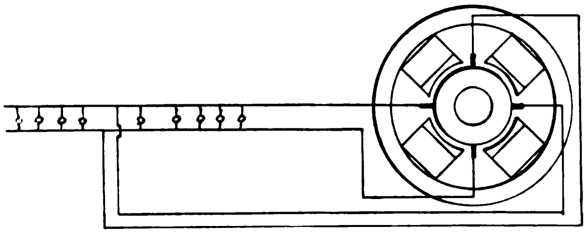


Fig. 3.

is connected to a water rheostat taking 125 amperes at 110 volts, while the other pair is connected to the same rheostat through two smaller rheostats corresponding to the resistance of a feeder. The voltage is then raised on the second pair of brushes to as high as 150 volts to deliver 125 amperes more to the main rheostat, thus overcoming a drop of 40 volts on the feeder. This is shown diagrammatically in Fig. 3.

In another experiment the machine carries one-half the full load on one pair of brushes at 110 volts, while the other pair is connected directly to the brushes of a separately excited elevator motor, and the motor is started and stopped and run at any speed and in either direction by varying the e. m. f. supplied to it by the dynamo; and although this variation is all the way

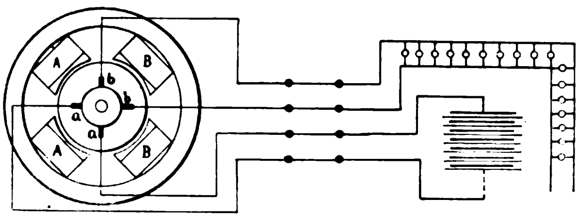


Fig. 4.

from 0 to maximum in sudden jerks, there is not the least interference with the lights on the other pair.

In connection with storage batteries the machine may run in parallel with the cells at full load, and at light load one or more of the pairs of brushes may carry the load while other pairs are connected to the battery, as shown in Fig. 4, and the voltage increased to any amount required for charging, thus doing away with boosters and wasteful resistances.

When the battery is employed to steady a fluctuating load,

the cells are connected to one or more pairs of brushes, as shown in Fig. 5, and by means of series coils on the poles acting on the sections feeding the battery, and arranged to oppose the shunt winding, the battery will automatically charge and discharge, as required, to keep the load on the engine constant at all times.

The same machine was shown in operation as a motor dynamo taking current at one pair of brushes and running at constant speed, and delivering current from the other pair, the voltage on the second or dynamo pair being varied from 0 to maximum by a rheostat in the corresponding field circuit, thus having all the advantages of a motor driven dynamo with better efficiency and without the extra cost of two machines.

Brushes are fixed and there is no sparking, even though current exceeds 50 per cent. overload over the whole range of voltage.

The principle on which the machine operates is similar, in

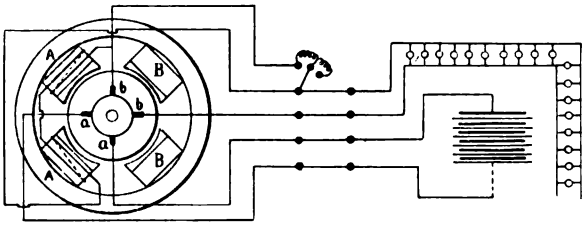


Fig. 5.

some respects to that of the Rushmore multi-circuit arc dynamo described in The Electrfical Engineer a short time ago, which consists in collecting the current from the armature in such a manner that the armature flux does not affect the strength of the poles under which current is directly collected.

This is shown in Fig. 6, which illustrates diagrammatically the course of the armature flux in a 4-pole machine, with ring armature, with current taken from one pair of brushes only, the field flux being omitted. In the diagram it is assumed that the total armature flux is four lines. It will be seen that two of the lines will circulate across the pole under which the current is directly collected, while the other two lines will pass through pole N′ in a direction opposing the field lines, then around the field ring and through pole N″ in a direction to assist in its magnetization, thus completing the circuit.

In this manner the effect of current in the armature through brushes a and b is to weaken pole N′ and to a like amount strengthen pole N″, while poles S′ and S″, under which current is directly collected, are unaffected. When the loads on both pairs of brushes are equal, the distorting influence due to one

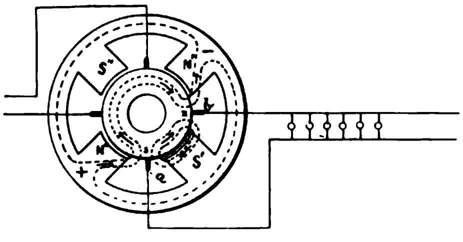


Fig. 6.

current is equal to and neutralizes that due to the other, and there is then no interference and the machine acts exactly the same as if operated in the usual way on a single circuit.

Various methods have been tried by Mr. Rushmore of winding series as well as shunt compounding and opposing coils on the poles to neutralize the effects of the armature currents, but as there is no interference whatever with the proper working of the machine when the currents are collected directly under only the unaffected poles, such devices have been discarded.

With a lap wound drum armature the distribution of the armature flux is more complex, as the current collected from a single pair of brushes passes before both poles of each pair.

All the poles in a four pole machine are affected, but as the current from each pair of brushes strengthens one of its poles as much as it weakens the other, there is no interference, and thus the only difference in the machine is that the armature must be of the multi-circuit or lap wound type.

"The Akron" Multipolar Generators and Motors.

THE gradual tendency of intelligent dynamo designs towards the ideal type of dyanmo which shall embody in one machine all of the fine points of construction, which previous experience has brought out is clearly shown in the new Akron multipolar apparatus manufactured by the Akron Electrical Manufacturing Company, Akron, O., and which is herewith illustrated.

The dynamo has a cast iron field yoke with laminated steel magnet cores and soft steel pole shoes, thereby giving an ideal, magnetic and structural condition, the laminated cores having a great capacity for magnetism and responding readily to the magnetizing influence of the coils encircling them, the cast iron makes a perfect welded joint between the cores and yoke, while the yoke has a sufficient cross section to add beauty to the design and rigidity to the whole frame, at the same time using only metal enough to provide for the magnetic circuit required. The soft steel pole shoes distribute the magnetic lines evenly over the armature, while the cross section of the cores is kept as small as is compatible with efficient results, thus reducing the copper losses in the field as much as possible. The armature is built up of fine laminations divided into three or more sections by small brass spacers having radial arms to create a blast of air through the core openings thus formed and across the ar-

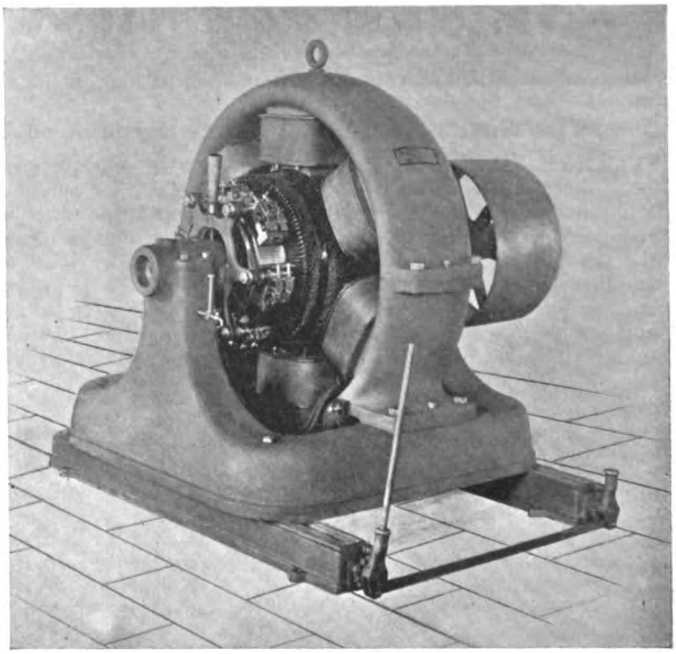


FIG. 1.—"THE AKRON" MULTIPOLAR BELTED GENERATOR.

mature winding. The spider which carries the core is of cast iron with radial arms arranged so as to admit air freely through the ends and force it swiftly through the passages formed by these spacers and the end flanges which also have radial passages for the air. This construction ventilates the armature perfectly and increases the radiating capacity enormously, keeping the temperature down far below the normal practice, and allowing heavy and continued overloads without injury to the dynamo. The machine-formed windings of the armature are perfectly formed, then insulated by hand and embedded in troughs made of mica, paper and press board.

The commutator is made up of drop-forged bars with India mica insulations put together at a high temperature and under enormous pressure so that it is impossible to move the bars when once it is assembled and turned true. The radial feed carbon brushes have large bearing surfaces on the commutator which make them run almost noiselessly and cool and are connected at the top by means of flexible copper strips to the brush holder body thus making a positive, metallic circuit from the commutator to the dynamo's terminals and being highly polished brass holders, they also add materially to the beauty of the apparatus. The bearings are self-oiling and self-aligning securely held in pedestals cast integral with the base frames, while the belted units are provided with sliding base rails having

convenient ratchet screws attached for tightening and loosening the belt. The generators are, taken as a whole, neat and pleasing in design, thorough in construction and so conservatively rated that they may be operated continuously under 25 per cent. overload with temperatures not exceeding 50° C. above the sur-

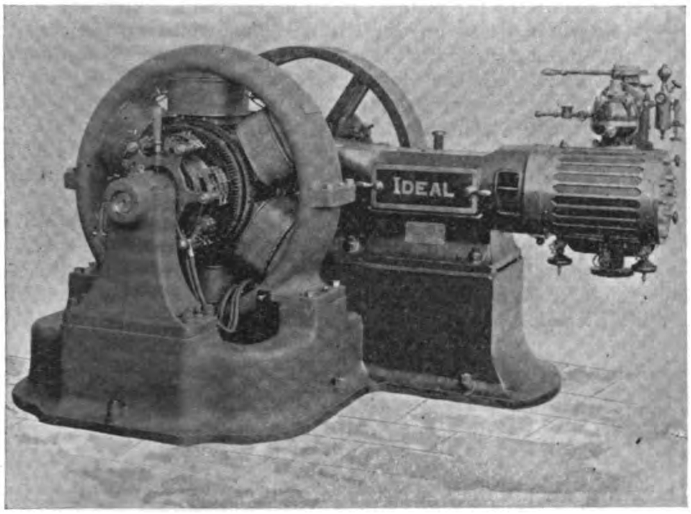


FIG. 2.—THE AKRON MULTIPOLAR DIRECT-CONNECTED GENERATOR.

rounding atmosphere and with temporary overloads of 50 per cent. without injuring them in any way. They are made for direct connected, slow, and moderate speeds and average in size from ¾ k. w. up to 300 k. w. in the generators and from 1 h. p. to 400 h. p. in the motors.

MR. FRANK A. ROGERS has resigned his position as general manager of the Card Electric Company, Mansfield, Ohio, after having served in that capacity for the past two years. It will be remembered that Mr. Rogers was formerly connected with the Brush Electric Company, Cleveland, Ohio, and was in their service continuously for fourteen years; and latterly with the Short Electric Railway Company. This is certainly a remarkable record and Mr. Rogers has the best wishes of his numerous friends for his success in whatever field he may enter.

Electrical Transmission in the Factory of the Western Wheel Works, Chicago.

THE WESTERN WHEEL WORKS, at Chicago, are just completing changes that will result in the driving of practically their entire plant by electric motors. Some idea of the magnitude of the factory can be gained from the information that its present capacity has an output of between seven and eight hundred bicycles in ten hours, and that when working full force 1,800 hands are on the pay roll. It occupies a majority of the space of a large city block, at Wells and Schiller streets, and consists of a number of buildings built or acquired from time to time as the business grew.

The present electrical transmission to the various departments of the factory which has taken the place of belts is not the result of any great and radical changes, but has been rather a natural outgrowth of the conditions. The time came when the factory plant had to be enlarged, and it was an easy matter to put in electric motors to drive the machines in the additions rather than go to the trouble and expense of putting in a lot of new belting and shafting to transmit the power to the various departments.

The general plan is not to drive each machine with a separate motor (as this would be expensive and wasteful with the hundreds of very small machines used in a bicycle factory), but to have one or more motors to drive the shafting in each of the numerous departments. This does away with the shafting running from one part of the plant to another and also abolishes the wasteful nuisance of belting vertically from one floor to another. The greatest saving, however, is during seasons of the year or hours of the day when some of the departments, or parts of departments, are not running. By shutting down the motor or motors running shafting not needed, all the loss in running unnecessary shafting is done away with, while formerly the entire friction load of the plant had to be carried as long as the engines were running.

On account of the growth and changes in the works it is impossible to tell exactly what the saving has been by the improvement. Mr. Geo. D. Van Tassel, chief engineer of the plant, and to whom is due the credit for its excellent arrangement and condition, states that previous to the introduction of electric transmission indicator cards taken from the engine showed a friction load of 50 per cent. The friction load with electrical transmission is, of course, more variable, but Mr. Van Tassel thinks the saving in cost of power for the factory is at least 10 or 12 per cent., although for the reasons stated no absolutely accurate figures can be obtained.

The central generating plant of the Western Wheel Works consists of two Heine water-tube boilers furnishing steam to two direct-coupled units. Each of these units comprises a Westinghouse compound engine running 261 revolutions per minute and a Westinghouse 125 volt generator. The rated capacity of these units is 430 h. p. each, but 530 h. p. has been lately obtained in emergencies by raising the steam pressure to 185 pounds. The generators are compound wound to provide for a small line loss of about 3 per cent. The switchboard is the regular type used by the Westinghouse Company for railway work. The wiring is a splendid example of good workmanship and intelligent design of circuits. Open cleat work is used throughout and extra precautions are taken at switches and fuse blocks to prevent crossing of wires.

The following is a list of the motors in use. A few of the larger machines were formerly used as dynamos before the present direct connected plant was built.

Two 65 h. p., one 25 h. p., one 50 h. p., and one 5 h. p. Mather motors; six 30 h. p., two 20 h. p., one 35 h. p., one 40 h. p., and three 10 h. p. of the Gibbs type; one 75 h. p. and one 7½ h. p. General Electric; and a 25 h. p. Westinghouse motor. A total of 642½ h. p.

Every motor has an automatic starting rheostat, and all care of the motors is under charge of the chief engineer's department. Whenever a motor is automatically cut out it is indicated by an annunciator drop at the central switchboard. It will be noticed that in many cases there are several motors to each department, the obvious advantage being that when the works are not running full force, part of a department can be shut down.

Visiting engineers will find a warm welcome at the hands of Chief Engineer Geo. D. Van Tassel who will, we know, extend every reasonable courtesy.

The Electric Headlight not an Element of Danger.

Officials of the Peoria and Eastern Division of the "Big Four" Railroad have made a test of an electric headlight, the Indianapolis "News" reports, to determine whether or not it is true, as some railroad men assert, that the use of a powerful headlight adds an element of danger. It was claimed that the reflected glare from the surface of the switch lamp lens is often so great that it entirely overpowers the light coming from the lamp, and will show apparently white light to the engineman, while the signal may be standing at red or green. Just the contrary result was obtained in the Western test. A green light, the most difficult to distinguish, was plainly visible at a distance of half a mile, and the red lights seemed to be magnified, being clear-cut in contrast to the pure whiteness of the electric headlight. The engineer, who has ridden behind an electric headlight for

twenty months, said that he had not the least difficulty in distinguishing the different lights on the road. It seemed to him that by contrast the colors on targets were made more distinct by the electric light.

Third Rail Successful in Severe Tests.

The superintendent of the New England Railroad says that the present third-rail system on that line will be extended from New Britain to Bristol before May, and the run between Hartford and Bristol, eighteen miles, will be made in thirty-five minutes. The third-rail line now in operation has just stood successfully the test of a severe ice and snow storm, losing but one trip between Hartford and New Britain during a day, but has yet to be tested by a heavy snow storm. It is stated officially that the New England Road had not decided to put on the composite between Hartford and Rockville to compete with the newly opened trolley line between those cities.

Thompson Electric Conduit System.

A PATENT has just been issued to R. F. Thompson, of Alexandria, La., for an electric railway conduit system embodying a very ingenious device for protecting the trolley wires from the seepage water that usually drops from the walls of the conduit or the water that passes in through the trolley slot. He accomplishes this object by means of two chambers of inverted trough shape, one chamber being located on either side of the trolley slot. The side walls and roof of these chambers are air and water tight, thus preventing any water from leaking into the same, and the only manner in which water can enter the chambers is by means of the bottom when the conduits become flooded, and in that event the water cannot rise to a sufficient height to reach the trolley wires, which are suspended from the roof of the chambers, by reason of the pressure of the air confined in the upper part of the chambers. When the grade changes, air and water tight partitions or diaphragms are provided, one in each chamber, with suitable means for permitting the trolley or plow to pass under the partitions. The patent was issued on January 11, 1898, its number is 597,036 and it appears to be one solution of the problem of insulating bare conductors in electric street railway conduits under all conditions of flooding of streets.

A Spiral Electric Railway For Niagara.

IT is intended that a great spiral railway, operated by electric power from Niagara Falls, shall be to the proposed Pan American Exposition, to be held on Cayuga Island, Niagara Falls, what the Ferris Wheel was to the World's Fair and what the Eiffel Tower was to the last Paris exposition. General plans for this conception have been made, and the details are being worked out. The basis for the railway is to be a huge circular tower of steel frame work, 500 feet high, around which, like the thread of a screw, the spiral railway will run supported on powerful brackets securely joined to the frame work of the tower. The tower will have a diameter of 80 feet at the bottom and the taper will be 30 feet to the 400 feet level, giving a diameter at that point of 50 feet. Around this tower the railway will run, rising 40 feet to the complete circle, thus passing 10 times around the tower in reaching the 400 feet level, where there will be a platform, which will be the terminus of the line. A ratchet rail will be used for the cars to make the climb on the same principle as the ascent of the Mount Washington and Pike's Peak roads. The grade of the road will be from 17 to 25 per cent. Protective devices will be used to assure safety, and it is expected that passengers on the spiral railway will be better protected than those on electric or steam railway trains. When the passengers are ready for the trip they will be seated facing outward, away from the tower, and thus the view will grow better and broader as the car ascends. Far away into Canada, up the river to Lake Erie, down to Lake Ontario, across one of the most beautiful sections of country to be found in the world, the eye will go with delight. The cars will never meet or pass except on opposite sides of the tower, the two tracks being erected on parallel but independent spirals.

At night the whole structure will be outlined in electric lights. Up and down the cars will move glittering with incandescent lamps, while from the top of the tower a powerful searchlight will illumine the falls, rapids and the exposition grounds. Above this still, a great glass globe will shine with light from within. The idea was conceived by George A. Ricker, chief engineer of the Gorge road at Niagara.

The Chicago and Englewood Storage Battery Road.

THE results of the tests of this pioneer road, which are discussed in detail on our editorial page reflect great credit on all connected with the management and equipment of that road. Of the former we may mention G. Herbert Condict, general manager; Hugh Hazleton, in active charge of the power house; H. B. Quick, superintendent of track construction; B. J. Arnold, consulting engineer of the company; and J. H. Vail, the well known electrical engineer of Philadelphia. The boilers were installed with the Roney stokers, by the Heine Boiler Company; the triple expansion condensing Willans engines by the Bullock Manufacturing Company; the generators by the Walker Company; the pumps and cooling tower by Henry R. Worthington, and the storage battery equipment by the Electric Storage Battery Company.

MECHANICAL

Physical and Chemical Properties of Volatile Oils in Boilers.[1]—I.

BY W. H. EDGAR.

NOT having written a paper, I will speak on the subject of the use of volatile oils, hydrocarbon, kerosene and oils of that nature, in the steam boiler. I do not believe there are many cases in this country where we get petroleum or other oils in our feed water supply, but the general laws of nature are such that our waters are heavily impregnated with lime and magnesia, which are the main ingredients, the scale forming salts, which form an incrustation in the steam boiler, which incrustation is a poor conductor of heat as compared with iron, so that we are forced to look around for something to counteract the evil effects of this incrustation and to get rid of it if possible; so that has led us to put most everything into our steam boilers and among the different reagents employed have been volatile oils. These volatile oils, including turpentine and oils of that nature, are all hydrocarbons and when they have been put into steam boilers have caused a corrosion or general eating and deleterious effects upon the boilers from their use.

There are two ways of looking at this subject of incrustation and its proper antidotal reagents. A boiler is very much like the human system: we are liable to injure it and we are liable to put something into it where the after effects are worse than the disease; so we must take up both sides of the question. Now, I want to bring out a few points about volatile oils and kerosene. Kerosene is a light distillate hydrocarbon and has been used very extensively throughout the country, or tried here and there, and dropped for one and another reason, and I will offer these suggestions and take up these points without any personal motive whatever, for I have none; but I will just simply take up the evil effects of kerosene and petroleum and their different distillates. Kerosene pumped into the steam boiler with the object of converting the incrustation into such form that we can readily wash it out, or prevent its formation, I will consider in the first place. Kerosene is a hydrocarbon. If we had a carbonhydrate, an animal oil, we would get an oleate radical and could possibly get the oleate of lime or oleate of magnesia, which, however, would not help us out; but we could get a chemical reaction from carbonhydrate, having a combining acid radical there; but in the hydrocarbons we have no possible acid radial; we have not the base; we have not the combination that will take the place of either base or an acid radical and we get no chemical reaction whatever and the action of the kerosene is purely mechanical, following the laws of capillary attraction. If I dip a blotter into water, the water will run up the side and penetrate the blotter; if the blotter is set over a tumbler of water, the water will penetrate through the sub-

[1]Abstract of an address before the Northwestern Electrical Convention, Milwaukee, Wis., January 20, 1898.

stance of the blotter; and if you play a hose on a brick wall the moisture will penetrate to the other side. Now, kerosene, being a light volatile oil, will penetrate everything of a porous nature such as lime, magnesia, etc., and will penetrate to a greater extent and more rapidly than water. The scale incrustation in the boiler will be softened, will be penetrated by this kerosene, due to the laws of capillary attraction, the scale being porous, the kerosene will work through to the iron and when it comes in contact with hot metal, the oil will run back of the sheet of the scale between the scale incrustation and the iron, and when you shut your boilers and draw your fires and let out your water, your boiler contracts, the iron contracting and expanding with the application of heat. Now, you have put a substance of different physical properties, of a different nature, between your lime and magnesia incrustation, and your iron sheet or plate. The lime and magnesia, little particles of them, will attach themselves to the sheet, due to the general affinity that they have for hot metal; they cling very tenaciously to the iron and when this substance comes in between, you have lessened that adhesive property and the incrustation is not adhering as tenaciously, and consequently being a non-conductor and not expanding and contracting uniformly with the iron, it is more readily scaled off and you get a great quantity of this broken scale from the continued use of a volatile oil such as kerosene. The kerosene does not change the chemical composition of the scale, its action is purely mechanical.

Now, there are other points to be looked at. Kerosene volatilizes in the steam boiler; you get probably a third over with your steam; it passes off immediately and begins to come over from above 150 degrees to 300 degrees Fahrenheit. (I was going to bring a little retort and a receiver up here, but thought it would be in the way and we would not be able to set it up.) This kerosene that passes over, constitutes hydrocarbon distillate and your steam is hydrogen and oxygen, and you know the evil effects from condensation in a steam plant; you know that every year you have in your heating system to put in a few more nipples or an elbow here and there. When you put in a light volatile oil of a hydrocarbon nature, you intensify that action and you get a series of oxydizing hydrocarbon reagents that will intensify that general pitting and grooving 1,000 per cent., that is, you will get the general eating through of the joints and connections probably ten times as quick as you would otherwise. Besides that, the kerosene is carried over into your cylinders. It is a part of the cylinder oil in the first place; they all come from the petroleum, except the animal oils. The kerosene is a solvent for them. It dilutes your cylinder oil; it has a tendency to change its lubricating properties just that much, and with the hydrogen and oxygen of the water and the compound formed in the distillate, you will get blackening of your piston rods and the deleterious general oxidizing effect on your rings, and if you have a metallic packing you will have hard work keeping your packing in your engine. From these same distillates, these same products formed in your distillation, you will have the pitting and the general eating through of all the threads of your joints and connections, through your entire steam system; not only that, but the part that is left in the steam boiler and the part that goes through your scale and reaches the iron cannot stand that high heat. It is carbonized; it is all decomposed, and in the carbonizing of the hydrocarbon oil in the presence of iron or against the iron sheet, you are going to carbonize your iron and you will have there a blistered appearing spot where the iron has been carbonized; it will be of a blackish, blistered appearance, and you will get that action all through the water submerged part of your boilers; and you will never get all your scale out with kerosene; you will never get more than a third, and those who are using kerosene and claim it is working fine, simply look at the scale that they take out and do not look into the boiler to see what is left. In my travels I have had some of my best friends tell me that they have used kerosene and their boilers are clean, their system is in good shape and I have gone down to their plants and looked around, and in the steam system from the boilers to the engine, I have seen the little leaks, and when this leakage does start in and the flange gives out and you have to put a new one in, in taking that apart you jar the whole system and bring to sight more leaks where your piping is half eaten through and almost ready to leak. Of course, an old plant will show up leaks in a few months or a year, but a brand new plant will disclose leaks in time if you continually use kerosene.

SOCIETY & CLUB NOTES

American Institute of Electrical Engineers.

The one hundred and twenty-first meeting of the institute, which was held at 12 West Thirty-first street, New York, Jan. 26, was devoted to the discussion of the question of Standardizing Generators, Motors and Transformers. The discussion was opened by Mr. E. W. Rice, Jr., and was participated in by Messrs. Lozier, Kennelly, Wolcott, Hutchinson, Moscrop, Lieb, Dunn, Coho, Pattison, Henshaw, Steinmetz, Mailloux and Osterberg. The appointment of a committee to consider the question was suggested, and subsequently the whole matter was referred to the council for such action as it may deem proper.

At the meeting of the council in the afternoon the following associate members were elected: Chas. R. Bangs, special agent, American Telephone and Telegraph Company, 15 Dey street, New York; M. C. Beebe, assistant in electrical engineering, University of Wisconsin, residence, 271 Langdon street, Madison, Wis.; Hugh Thomas Brown, superintendent of electrical department, Selma Gas and Electric Company, Selma, Ala.; Edward P. Burch, electrical engineer, Twin City Rapid Transit Company, 517 Sixth avenue, S. E., Minneapolis, Minn.; Eben Clinch Crocker, electrical engineer, American Ordnance Company, 29 Harriet street, Bridgeport, Conn.; Albert B. Elias, electrician, Davis Coal and Coke Company, Thomas, West Va.; Alex. Stanley Garfield, engineer, Thomson-Houston, Cie 27 Rue de Londres, Paris, France; Chauncey Graham Hellick, electrical engineer, The Chicago Telephone Company, residence, 193 Dearborn avenue, Chicago, Ill.; Jacque L. Morgan, electrical inspector, Kansas City Fire Department, residence, 1702 Locust street, Kansas City, Mo.; Herman A. Prosser, electrician, Baltimore Copper Smelting and Refining Company, Keyser Bldg., residence, 1222 Madison avenue, Baltimore, Md.; John Joseph Swann, assistant editor, "Engineering News," 220 Broadway, residence, 347 West Thirty-fourth street, New York; C. Walton Swoope, instructor, electrical engineering, Spring Garden Institute, residence, 12 North Thirty-eighth street, Philadelphia, Pa.; Jin Tachihara, General Electric Company, residence, 106 Union street, Schenectady, N. Y.

The Indiana Mutual Telephone Association.

THE annual meeting of this association was held at the Bates House, Indianapolis, Ind., on January 19, 1898. E. H. Andress, of Lafayette, president of the association, said that the independent telephone business throughout the State is on the increase, both in the number of subscribers to older exchanges, and in the number of new exchanges which are being put in. He said that in the beginning the home companies were regarded by competitors as short-lived, but the independent organization had now become a factor which is outgrowing the Central Union Company in strength. This showing indicated that home companies should continue to "stay in the thick of the fight." It was also stated that where a home company and the Central Union are at war the people are inclined to the home organization.

George W. Beers, of the Home Telephone Company, of Fort Wayne, says the company has 1,400 subscribers and charges a rental of $36 a year for telephones in business houses and $24 for those in residences. Where a subscriber has both, the rate is $48 a year for the two. He said the company has seven hundred miles of wire reaching other towns in Indiana and Ohio.

A committee was appointed at the last annual meeting to confer with similar committees of independent associations in Pennsylvania and Ohio. This report showed that the independent enterprises were carried on in these three States named to a greater extent than in others. In the three States there are 250 independent exchanges, with more than 100,000 subscribers, and the capital invested is more than $5,000,000. The report said that the demand upon home companies is now for more extended, or long distance service. That this end might be reached it was stated that in the three States organizations are forming. To further this work, committees from the three States had been appointed. That from Indiana consists of E. H. Andrews,

George W. Beers and Hugh Daugherty. The committees had conferred with the Western Union and Postal Telegraph Companies, with the object of forming an alliance of some kind whereby the long distance lines might be established. But the possibilities are so remote, the committee said, that about the only way to obtain the desired result is to incorporate the independent exchanges of the State into a company, with sufficient capital to build the connecting lines. It was recommended in the committee's report that this movement be taken up at once and developed as rapidly as possible.

The following officers were elected for the ensuing year: President, E. A. Andress, of Lafayette; vice-president, J. S. Stone, of Rushville; secretary and treasurer, A. E. Reynolds, of Crawfordsville; assistant secretary, W. H. Ernst, of Blumton. Executive Committee: E. H. Andress, J. S. Stone, A. E. Reynolds, George W. Beers, of Fort Wayne; C. M. Zion, of Lebanon; Elbert Shirts, of Noblesville; A. E. Ramsay, of Crawfordsville.

The Civil Engineers' Club of Cleveland.

The semi-monthly meeting of the club was held in its room in Case Library Jan. 25, 1898, at 7.45 P. M. President Ritchie in the chair. Mr. Samuel T. Dodd read a paper on the subject of "Power Consumption on Electric Railroads." He discussed the resistance developed by moving cars, and reviewed the formulas which have been in common use to express this resistance, comparing the results obtained by them with a number of recent instances upon electric railroads. He concluded that experience shows that the old formulas, while giving results rather high at low velocities give too small resistances at high velocities when applied to electric motors. The author also discussed tne question of acceleration and the power required to bring the car to a certain maximum velocity and the number of seconds in which this may be accomplished. He adduced instances from the practice of several of the inter-urban roads about Cleveland and showed that about 400 pounds per ton was the maximum horizontal effort to be expected from the electric motor. The paper was accompanied by a number of diagrams and tables illustrating the subject.

Engineers' Club of Chicago, Ellicott Lecture on Fire Alarms.

City electrician E. B. Ellicott, of Chicago, delivered a lecture on city fire alarm systems before the Engineers' Club of Chicago the evening of Jan. 28, at the rooms of the club, 1800 Fisher Building. The object of the lecture, as stated by Mr. Ellicott, was to give an idea of the workings of the Chicago fire alarm system without going far .nto electrical details. A fire alarm circuit was run into the room, and the lecutrer's remarks were supplemented by a practical demonstration of the process of giving an alarm. Assistant city electrician, D. M. Hyland, who has been connected with Chicago's fire alarm department for twenty-five years, was present and assisted in the demonstrations. The Chicago fire alarm system received quite an impetus after the great Chicago fire, and it has been constantly improved by those connected with it until there is probably none better in the world to-day.

Henry Electrical Society.

The ninety-sixth meeting of the Henry Electrical Society will be held at Columbia University, Engineering Building, Room 502, on Friday, Feb. 4, 1898, at 8.15 P. M., when A. H. Ford, E. E., will deliver an experimental lecture on "Transformers."

Third Annual Convention of the National Association of Manufacturers.

This convention, the most notable in the history of the association, was called to order in the Masonic Temple, New York City, on Tuesday morning, January 24, by President Theodore C. Search. At that time over 400 representatives of industries from the North, South, East and West filled the auditorium, including also delegates who represented the manufacturing interests of foreign countries and are here investigating American methods. The president's report contained some valuable statistics and information regarding our exports, the shipping question, the Nicaragua canal, commerce and industry, sample warehouses, technical education, reform oi the consular service, international banking, the bankruptcy law, State taxation, patents and patent laws, the metric system and the Paris exposition of 1900. The committee on languages, weights and measures submitted a report in favor of the metric system. On Wednesday and Thursday the report of President Search was discussed, and on Thursday evening over 1,000 delegates, guests and friends attended the banquet at the Waldorf-Astoria. President McKinley delivered a stirring patriotic address, in which he referred in glowing terms to the work oi the association. Conspicuous among the delegates were: C. A. Benton, Sprague Electric Company, New York; C. F. Lunkenheimer, Cincinnati, O.; James Watson, Otis Bros. Mfg. Company, Yonkers; Fred B. Smith, Ferracute Machine Company, Bridgeport, Conn.; Charles A. Schieren, Sr. and Jr., New York; Charles A. Moore, Manning, Maxwell & Moore, New York; Chas. T. Hughes, General Electric Company, East Orange; H. S. Manning, Shaw Electric Crane Company, New York; Walter L. Pierce, Lidgerwood Mfg. Company, New York; N. B. Lyons, Bullard Machine Company, Bridgeport, Conn.; Theo. F. Miller, H. R. Worthington Pump Works, Brooklyn, N. Y.; W. E. Gilmore, Edison Phonograph Works, Orange, N. J.; C. E. Bigelow, Geo. F. Blake Company, New York; C. E. Billings, Billings & Spencer Company, Hartford, Conn.; Richard Butler, Butler Hard Rubber Company, New York; F. L. Bigelow, The Bigelow Company, New Haven, Conn.; E. P. Atkinson, Charles A. Schieren & Company, New York; Franklin Phillips, Hughes & Phillips Company, Newark, N. J.; E. P. Bullard, The Bullard Machine Tool Company, Bridgeport, Conn.

Chicago Electrical Association.

AT a meeting of the above association, held at Chicago Jan. 7, 1898, Mr. H. G. Dimick read a very interesting paper on "Electrical Shop Transmission." In discussing this subject Mr. Dimick confined himself largely to the two-wire 220-volt system and motors belted to line shafting. He gave very practical suggestions for changing the equipment from belt to motor-driven, describing the switchboard apparatus required for the motor equipment, the connections on the board and the distribution of the electrical energy for power purposes. He illustrated his remarks by numerous illustrations and his treatment of the requirements of an automatic starting rheostat was thoroughly practical and exhaustive. In closing his address Mr. Dimick very aptly said: Taking all in all, shop transmission probably gives rise to as many problems of construction as any other branch of electrical engineering, and is a distinct class of work in itself, to be met and dealt with in the best possible manner, and then wait for experience to prove the need of something simpler, cheaper and better.

The spring programme of the association includes the following papers: Feb. 4, "Electricity in Ship Building," C. C. Mattison, engineer, Chicago Ship Building Company; Feb. 18, "Electricity in Medicine," E. W. Jewell, McIntosh Battery and Optical Company; March 4, "Relationship of the Hunter and Tesla Patents," A. Miller Belfield, patent attorney; March 18, "The Autobiography of a Piece of Wire," C. T. Gage, Washburn & Moen Mfg. Company; April 15, "The Electric Railway," W. R. Garton, R.R. Man., Central Electric Company; May 6, "The Enclosed Arc Lamp," J. M. Hollister, Western Electric Company.

The annual banquet will be held on May 20. The officers of the association for 1898-'99 are: F. S. Hickok, president; T. G. Grier, vice-president; E. J. Swartout, treasurer; J. R. Cravath, secretary; S. G. McMeen, J. M. Hollister and C. Wiler, directors. All communications should be addressed to the secretary, 825 Monadnock Building, Chicago, Ill.

Lectures on Electrical Engineering.

The Columbia University lectures in co-operation with the American Museum of Natural History for February will be given at the Museum, Central Park, Seventy-seventh street and Eighth avenue, on the following Saturdays, at 8 P. M.:

Feb. 5. Mechanical Sources of Energy, Prof. F. R. Hutton; Feb. 12. Generation of Electrical Energy, Prof. F. B. Crocker; Feb. 19. Transmission of Electrical Energy, Dr. A. E. Kennelly; Feb. 26. Utilization of Electrical Energy, Prof. Wm. A. Anthony. The lectures will be illustrated by slides and experiments. Tickets of admission are required. They can be pro-

cured without charge by application to the secretary of Columbia College.

PERSONAL

PROF. ELIHU THOMSON has a very interesting and complete review, in the January Forum, of the electrical advance of the last ten years.

MR. NIKOLA TESLA, according to the New York Herald, has had his hand examined by a palmist, from a photograph taken by vacuum tube light. According to the expert, Mr. Tesla, in spite of one very heavy loss, will make a great success in financial affairs and will be married twice. The line of Venus is strongly developed. This agrees with all that his friends do not know about him. The head line indicates a very shrewd and active mind.

ELECTRICAL EXHIBITION. FROM MAY-2 TO MAY-31-

Important Electrical Exhibition Arrangements.

WE are in receipt of the following from the Electrical Exhibition authorities: Aside from the fact that large amounts of space are now being taken up for the Electrical Exhibition next May, and that the flow of applications is such as to exhaust every possible and available square foot, a great deal of other preliminary work is going on quietly. A very important and interesting piece of news is the acceptance by Prof. F. B. Crocker, of the position of consulting engineer, on invitation of the management, which is desirous of associating with itself all that is best in regard to the technical side of the art. Prof. Crocker, who regards the exhibition as a highly useful means of reaching the public, is deeply interested in its success and wishful of promoting its beneficial influence in every way. His name as consulting engineer is a guarantee of good work being done under his supervision and by the construction staff in the disposition and safeguarding of the exhibits. Prof. Crocker, as president of the American Institute of Electrical Engineers and Professor of Electrical Engineering at Columbia University, represents the highest technical skill known in the profession; and the exhibition management felicitates itself upon this valuable acquisition.

In addition to this, an Auxiliary and Educational Committee has been formed to take general charge of exhibition matters other than commercial, and to co-operate with the Advisory Committee, which represents the New York Electrical Society. The Auxiliary Committee comprises men of the highest standing, all of whom intend to take an active part in the work and are now making extensive and interesting plans, of which note will be made from time to time. Mr. T. C. Martin, who was chairman of the very successful committee of the 1896 show, has again consented to serve in the same capacity. With him are associated, Prof. F. B. Crocker, of Columbia University; Prof. Morris Loeb, of the University of New York; Prof. W. E. Geyer, of the Stevens Institute of Technology; Dr. Chas. A. Doremus, of the College of the City of New York; Mr. Herbert Laws Webb, of the New York Telephone Company; Mr. J. B. Taltavall, editor of the "Telegraph Age"; Dr. Park Benjamin; Secretary G. H. Guy, of the New York Electrical Society; Mr. W. T. Wheeler, vice-president and national deputy National Association of Stationary Engineers; Lieut. G. O. Squier, U. S. A., and Mr. Thos. A. Edison, Jr., who is in charge of some special decorative and mechanical effects. It is believed that this committee enjoying as it undoubtedly will the heartiest confidence and co-operation of all, will be able to accomplish some extremely useful and memorable work in behalf of the science and industry.

As already announced, the New York Electrical Society, under whose auspices the exhibition is to be held, has already appointed an Advisory Committee entrusted with its interests, and composed of its present officers and past presidents, namely, present officers Dr. M. I. Pupin, president, and Messrs. Dunn, Sinclair, Case, Osterberg, Guy, Riker, Coho and Ker; and past presidents as follows: Messrs. F. W. Jones, Small, Pendleton, Crocker, Wetzler, Mailloux, J. W. Lieb, Jr., and Dr. C. E. Emery.

LEGAL NOTES

The Sprague Suspension Patent Decision.

The recent decision by Judge Wheeler in the Circuit Court with reference to the Sprague patent would appear to have created considerable misunderstanding. Tne broad claims of this patent includes suspending of an electric motor on the car axle at one end and spring suspending it at the other. If these claims were upheld it would be serious for all makers of railway motors except the assignees of the patent in question.

Such, however, the Walker Company point out is not the case. We quote from Judge Wheeler's opinion: "If Sprague's patent was merely for hanging and centering one end of a motor of a carriage upon the axle of the driving wheels and suspending the other by a spring from the body of the vehicle or truck, it would be shown from that case (meaning the St. Louis case) to be wholly lacking in novelty and void. He was not a pioneer here, and could have a valid patent only for what was new in his method of making the power of the electrical current turn the driving wheels."

"What was new in his method" consisted in supporting the armature bearings by a bracket fastened to the pole pieces, a device which is no longer used in railway motors. In using a motor pivotally suspended from the car axle, the Walker Company violates, its officials point out, no valid rights conferred on any one by reason of Mr. Sprague's patent, and the second feature of suspending the armature by brackets fastened to the pole pieces, the Walker Company says it does not care to use.

Judge Wheeler has issued an order suspending the injunction for 30 days, pending appeal if desired by the defendants.

THE STOCK MARKET

A Wonderfully Active January.

THE month that has just ended marks a good start for the New Year. Confidence in American securities has been one of its features. The transactions in bonds on the New York Exchange broke all records, reaching about $90,000,000, at advancing figures all around; while stocks have been equally strong and in demand. There is a remarkable ease in the money market, the banks carrying large surplus. Both the railroads and general business are in excellent shape, and Bradstreets summing up the situation remarks: "Favorable conditions in the trade situation continue to far outweigh those of an opposite character." The failures for the closing week of the month were the smallest for the last five years. Wheat is again higher.

During the week 20,454 shares of Western Union were sold, closing at 91 5-8. General Electric was stronger, and on sales of 14,305 shares advanced to 36¼. In Boston, American Bell Telephone was little dealt in, at prices from 267 to 270.

Copper is quoted at 11 cents. Heavy steel rails are $18. Lead is a shade lower at 3.60 cents, New York. Great activity is reported in the pig iron and steel markets.

THE "ARGONAUT," submarine boat, has been telephoning from under the water in Baltimore harbor to various points in Baltimore and Washington by means of 1,200 feet of insulated cable.

REPORTS OF COMPANIES

The Chicago Telephone Company.

The Chicago Telephone Company at its annual meeting on Jan. 19, 1898, reported that surplus after paying 12 per cent. dividends on its outstanding capital stock of $4,336,500 was $104,313.47. No report was submitted to the stockholders, except the following brief statement by Secretary C. E. Mosley:

	1896.	1897.
Gross earnings	$1,955,829.03	$2,072,079.55
Expenses	1,355,624.05	1,447,386.08
Net earnings	$600,204.98	$624,693.47
Dividends paid	499,224.00	520,380.00
Surplus for year	$100,980.98	$104,313.47
Capital stock outstanding Jan. 1, 1898		4,336,500.00

The following directors were elected by the unanimous vote of 38,298 shares: J. Russell Jones, John M. Clark, Norman Williams, Robert T. Lincoln, John de Koven, Byron L. Smith, Arthur G. Fuller, C. E. Perkins and William A. Jackson.

The only change was in the selection of Byron L. Smith to succeed the late George M. Pullman. The meeting adopted an amendment increasing the number of directors to eleven, and the two new places will be filled by the board.

The Central Union Telephone Company.

At the annual meeting of the stockholders of the Central Union Telephone Company, held in Chicago Jan. 19, 1898, President W. A. Jackson made the following financial showing:

	1897.	1896.
Gross earnings	$1,436,898.80	$1,333,082.37
Expenses—For administration, operating, maintenance and interest	1,156,505.44	1,091,872.74
Net revenue	$280,393.36	$241,209.63
Surplus	280,393.36	175,156.63
Added to construction account:		
At exchanges	$333,436.00	$416,942.77
For toll lines	487,004.94	271,659.39
Total	$820,440.94	$688,602.16

For the six months from Jan. 1 to June 30, 1896, there was received in gross revenue $67,213.19 from property operated in the State of Iowa, and a net revenue of $26,148.37; therefore, to make the comparison of earnings and expenditures for the years 1897 and 1896 upon an equal basis the Iowa earnings, as above, should be eliminated, since we have received no revenue from that source in 1897. The actual difference in favor of 1897 upon this basis is: Increase of gross earnings, $171,029.62; increase of net earnings, $65,320.10. The number of exchanges in operation this year is 153, an increase of 20. The number of subscribers Dec. 31, 1897, was 36,318, an increase of 4,674. The number of toll stations is 1,157, an increase of 202. The number of miles of wire in intertown lines is now 24,446. There has been constructed during the year in this class of property 2,298 miles of pole line and 9,352 miles of wire, almost the entire amount of which is of copper metallic circuit.

The following directors were re-elected by the unanimous vote of 45,895 shares: C. H. Brownell, R. C. Clowry, Arthur G. Fuller, F. H. Griggs, John E. Hudson, W. A. Jackson, J. Russell Jones, M. G. Kellogg, Robert T. Lincoln, John P. Wallick and Norman Williams.

There are 540 stockholders, and the last preceding report gave the outstanding stock at $6,605,300.

Gridironing Michigan—The Lansing, St. John's and St. Louis Railway Co.

The Lansing, St. Johns and St. Louis Railway Company have just been incorporated with a capital stock of $250,000. The company will devote itself to the construction of overhead trolley roads through the magnificent farming country of Michigan. They will traverse the following towns and cities: Lansing, St. Louis, Ithaca, Pompeii, Maple Rapids, St. Johns, and other small towns. Fifty-three miles of track have already been laid, not including side or spur tracks. The officers of the company are: M. V. Montgomery, president; Isaac Hewitt, vice-president; F. L. Dodge, secretary; A. B. Darragh, treasurer. The directors are: Jacob Stahl, M. V. Montgomery and Frank L. Dodge, of Lansing, Mich.; A. B. Darragh and Stiles Kennedy, of St. Louis, Mich.; Isaac Hewitt, Maple Rapids, Mich., and George P. Stone, of Ithaca, Mich.

Annual Report of the Southern New England Telephone Company.

The annual report of the Southern New England Telephone Company for the year ending Dec. 31, 1897, shows the following comparison:

	1897.	1896.	1895.
Gross	$594,831	$552,466	$503,716
Expenses and charges	430,677	397,444	391,814
Balance	$164,154	$155,042	$111,902
Dividends	150,000	103,491	86,250
Surplus	$14,154	$51,551	$25,652

Twenty-five per cent. of earnings came from toll-line business. The year began with 8,027 instruments in use and ended with 9,376, a gain for the year of 1,349 instruments, as compared with a gain last year over the year before of 1,020 instruments. All circuits of the company are now metallic. Twenty per cent. a year is charged off for cost of switchboards, and there have been other charges against depreciation of $18,000. The sum of $200,000 has been spent in construction during the year, chiefly derived from the new stock issued in 1897. There are now underground systems in New Haven, Hartford, Bridgeport, Meriden, Waterbury, Stamford and some smaller towns, and in New Haven and Hartford 800 subscribers take underground service directly into their houses. In the new limited service, 130,000 tokens were bought during the year. All but seven of the 168 towns in the State are now reached by the wires of the company. A test for sixty consecutive days between thirty-six switchboards of the company has indicated a total service of about 13,000,000 messages a year.

HUGO REISINGER, of New York, the well known importer of "Electra" carbons, has changed his office from 38 Beaver street, where he has been for so many years, and has taken an extremely handsome suite of offices on the fourth floor of the Bowling Green Building, 11 Broadway. Mr. Reisinger still retains his old warehouse accommodations, but has found it necessary to have larger and more commodious office facilities, as above noted.

OBITUARY

William Habirshaw.

It is with extreme regret that we note the sudden death of young Mr. Wm. Habirshaw, the only son of Dr. W. M. Habirshaw, of the India Rubber and Gutta Percha Insulating Company, of this city and Yonkers. He was taken ill with pneumonia about a week ago, and although all the resources of medical skill were brought to bear on the case, and in spite of a splendid physique, he succumbed to the disease on Sunday morning, Jan. 30. He was one of the best informed men in the wire insulation field, having enjoyed the training of his father and being closely associated with all the expert work in the laboratory at the large Yonkers factory. We can only extend our heartfelt condolence to the bereaved father and mother, in common with a host of distressed friends who had learned to admire and esteem their son, still so young and full of promise. The funeral service took place on Tuesday at St. John's Church, Yonkers, and the interment was at Woodlawn cemetery.

TRADE NOTES & NOVELTIES

"Express" Type Switchboards of the American Electric Telephone Co.

THE new "Express system" of the American Telephone Company, of Chicago, has lately been adopted by many independent exchange companies in all parts of the Union. Below we give a description and illustration of the "Express" switch-

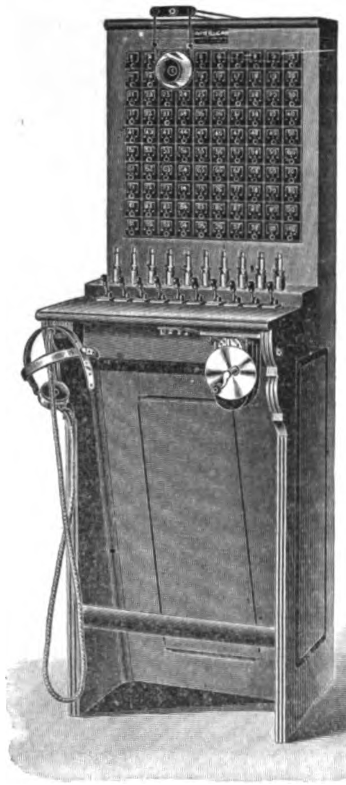


FIG. 1.—EXPRESS SWITCHBOARD, AMERICAN ELEC. TELEPHONE COMPANY.

board, which contains many admirable features of construction and ease of operation.

Each drop and jack in this board is mounted in a separate case, or shell, and hence, each of these little cases contain practically the vital and essential parts of the switchboard. The back of the board consists of a series of hardwood strips extending horizontally across the board inserted in a cabinet of the same, and each strip is of the same width as the height of the shell from top to bottom. There are ten of these wood strips and each strip is made for the insertion of ten drops. Along the front of each wood strip are run four strips of German silver. Two of these represent the generator circuits, and two the night alarm circuits. German silver springs—four in number—are mounted on the back of each of the drop cases. These represent the generator and night alarm terminals of the drop. Extending out from the back of each drop shell are also two substantial machine screws. In inserting these screws through holes bored in the wood strips, the drop is brought into its proper position in the switchboard, and the machine screws running through the board are provided with thumb screws or nuts. When these nuts are tightened, the drop is fastened securely in position in the frame, and at the same time, connection is positively and reliably made between the German silver bands or strips on the front of the wood strip on which the drop is mounted, and hence, night alarm and generator connections are made between the drop and the strip circuits.

Each 100-number section, whether equipped with full 100 drops or not, is wired for the full 100 lines, with a set of operator's instruments mounted and all circuits run, ready to connect the board to line terminals and put the same into operation without any inconvenience.

As to line connections, when the machine screws pass through the wooden strip, they also pass through a German silver punching which is provided with a lip, and when the nut is put on the machine screws, positive connection is made between these machine screws which represent the main line terminals and the German silver punching to the lip, to which is permanently soldered the line connection. Hence, the claim that a drop can be removed from and replaced in the switchboard within a few seconds' time without disturbing a single connection. As to the advantages assured in the way of accessibility of parts for inspection and repairs, this board is positively unequalled, and the great advantages in this respect are thoroughly appreciated by all its users.

All interior parts of the shell are nickeled and fully polished. Nothing but the very best German silver springs are used. Hard rubber is used throughout in providing for insulation, etc. The drops are the most sensitive to influence of magneto current of any ever made, and the drop shutter will fall where a 10,000 ohm generator is used through a resistance of upwards of 9,000 ohms.

All windings are with silk covered wire. The drop coils themselves are inserted in a non-inductive metal shell. This metal shell containing the drop is placed in the shell which contains the combined drop and jack. The plugs are of the "round" type and of the utmost durability; jacks are positive in action, allowing of no possibility of the leaving of a line open, or introduction of high resistance into the circuit owing to poor contact.

As to the method of operating the board, but three moves are required to answer a subscriber's call, restore drop shutter on line calling, ascertain the number wanted and ring the station required. The board is absolutely clear of patent infringement. The use of a clearing out drop is done away with; the main line drops act as ring-off drops. When a call is answered, the drop is automatically restored by the insertion of the plug into the jack of the line calling. When parties are connected by means of a pair of cords and plugs, when desiring disconnection, and ring-off, the drop shutters of lines connected fall, and when the plugs are removed from the jacks, shutters which are displaced by the ring-off, are automatically restored, the operator never being required to touch a drop shutter with her hand.

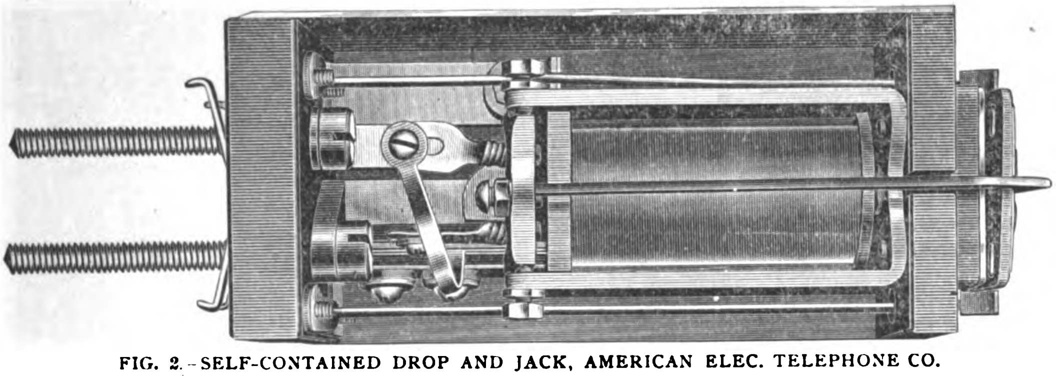


FIG. 2.–SELF-CONTAINED DROP AND JACK, AMERICAN ELEC. TELEPHONE CO.

The operator's set includes a powerful magneto hand generator wound to ring through from 35,000 to 40,000 ohms resistance and having heavy quantity output, thus being adapted for ringing of series bells on short lines and those of high resistance,

and the ringing of a maximum number of bridging bells on long bridged lines; a long distance solid back amplifying transmitter suspended from a neat arm and adjustable as to height and distance from face of board; a long distance type silk wound induction coil with hard rubber heads, screw and washer terminals and soldered connections; a compound telephone watchcase receiver; a special nickeled spring operator's headband, cords, terminal plug and metallic jack.

The cut shows the American Telephone and Electric Company's "Express" switchboard combined. The drop and jack can be removed from and replaced in switchboard within a few seconds' time without disturbing the line, generator or night alarm circuits.

Express switchboards are furnished adapted for use in exchanges of any size up to several thousand lines. The company has filled orders within the past few months for boards aggregating upwards of 10,000 drops. The business of the company is rapidly increasing due to the excellence of their products, and the energetic efforts of Mr. H. C. Dodge, the general manager of the company, to whom we are indebted for the above data.

New Apparatus of the Western Telephone Construction Co.

THE accompanying cuts represent some of the new types of apparatus manufactured by the Western Telephone Construction Co., of Chicago. They certainly deserve more than

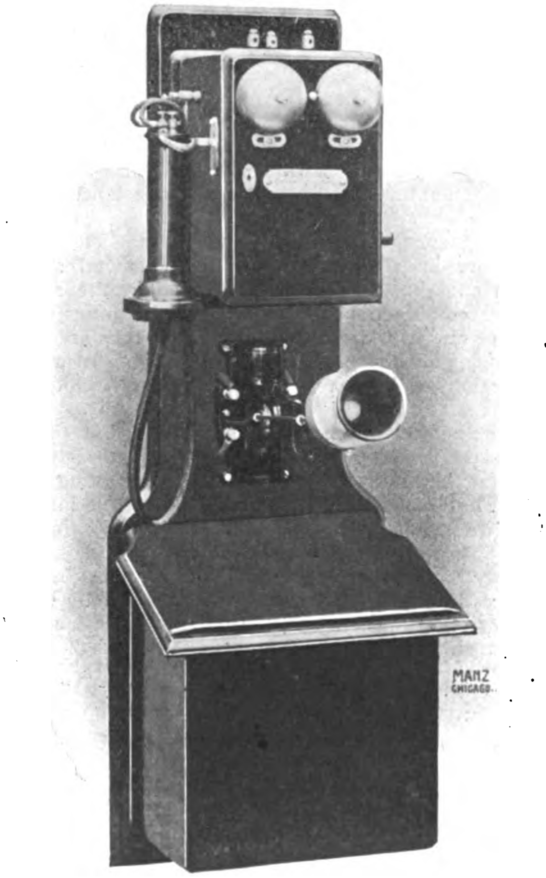


FIG. 1.—ROCKER ARM WALL SET, WESTERN TELEPHONE CONSTRUCTION CO.

passing notice for their artistic design and handsome finish, to say nothing of their good mechanical and electrical qualities.

Fig. 1 represents their rocker arm wall set which embodies all of the latest improvements known to this type of instrument. The powerful granular carbon transmitter of this company is mounted upon an iron rocker arm, handsomely enameled and decorated in gilt. In the base of this arm is placed their new long core, all silk induction coil, specially designed to give best results with this particular transmitter. The receiver is of their well known bipolar type, and all of the contact points of the hook switch are of platinum. These instruments are furnished in oak, cherry or walnut.

Figs. 2 and 3 represent their new cabinet desk sets, which for general elegance would be hard to surpass. They are furnished in either oak or cherry, and upon special order in mahogany or any other wood desired. Four different designs are

FIG. 2.—CABINET DESK SET; WESTERN TELEPHONE CONSTRUCTION CO.

being turned out by this company, of which but two are illustrated here.

In Fig. 3 the generator, hook switch, ringer and induction coil are all in plain view, being seen through the beveled glass panel in the front of the cabinet. All of the metal parts of these pieces of apparatus are highly nickel plated and polished.

In Fig 2 the working parts of the instrument are concealed, and a beveled edge mirror is mounted upon the backboard.

FIG. 3.—CABINET DESK SET, WESTERN TELEPHONE CONSTRUCTION CO.

By mounting the transmitter arms at the extreme left hand side of the top board of the cabinet, the desk room is not inter-

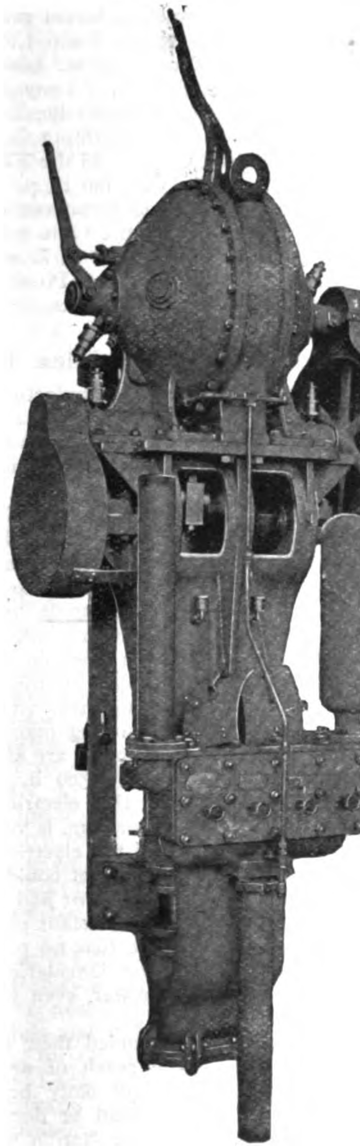
fered with, thus adding greatly to the convenience of the instrument.

The Western Telephone Construction Company reports a very gratifying sale of these types of apparatus.

G. E. Mine Sinking Pump at Pachuca, Mexico.

A MINE SINKING PUMP, compact in form, of full rated capacity and efficiency and not easily damaged by moisture or hard usage has recently been constructed by the General Electric Company. The pump is of the duplex double acting type with outside packed plungers. Its cylinders are 5 x 6 inches; it runs at 75 revolutions per minute and has a capacity of 150 gallons against 300 feet head. It is driven by a specially designed 15 h. p. enclosed induction motor in which the gears and all the mechanism are completely protected by a water-tight steel casing.

The shaft and starting lever pass through stuffing boxes. The



G. E. MINE SINKING PUMP.

casing was tested for leakage with steam pressure up to 35 pounds per square inch. The wearing parts are all large and of extra heavy design, the crank shafting being one solid forging fitted with brass bearings. The connecting rods are of the marine end type and are forged. The guides are bored in the intermediate mechanism so that the cross head must always be in line with the pump cylinders. By removing one plate on the pump, all the valves may be reached at one time.

This sinking pump was designed to withstand without injury all the hard usage to which mining machinery is subjected. As the case is water tight, the pump works as well under water as out. It may be completely "drowned" by a sudden inrush of water in the mine but its operation is not affected. This pump is now in operation at Pachuca, Mexico.

Telephone Box Hardware.

Hammacher, Schlemmer & Company, of 209 Bowery, New York, call attention in our advertising columns to one of their many lines, viz., telephone box hardware.

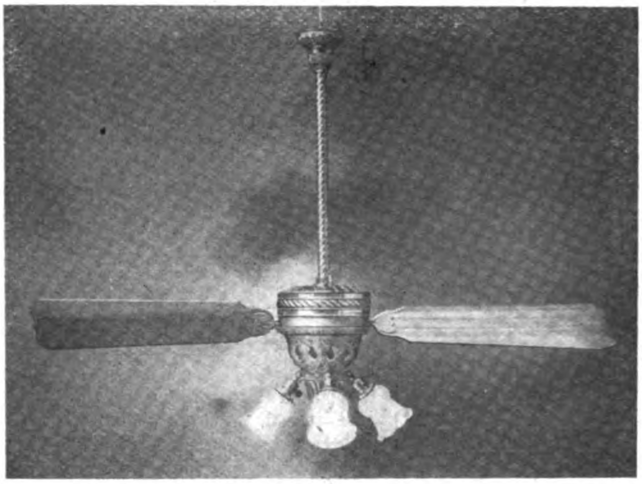
Their extensive connections in the cabinet hardware line give

TELEPHONE BOX HARDWARE.

them exceptional facilities for supplying goods of this character. In addition to this class of hardware they handle a large line of factory supplies, wood working and metal working tools, spring wire, belting, emery wheels, etc. Their 400 page catalogue of tools is a perfect encyclopedia of the line.

Hunter Direct Current Fans.

OUR illustration shows a very handsome ceiling fan manufactured by the Hunter Fan and Motor Company, Fulton, N. Y. The motor, which is enclosed in an artistic casing, is of the direct current type. It has a toothed armature, powerful soft-steel fields, and a short magnetic circuit. The two bearings, which are submerged in oil, are spread far apart so as to prevent the armature from rubbing against the poles, as is



HUNTER FAN MOTOR FOR 1898.

often the case with a short single bearing, after it gets worn a little. The motor consumes very little current, using less than one ampere at a speed of 192 revolutions per minute; and has a five foot sweep of the blades. The speed can be varied by a two-speed switch on the bottom of the fan. The company manufacture direct and alternating current electric and belt-driven ventilating fans of every description.

Roebling's Climax Resistance Wire.

John A. Roebling's Sons Company have just issued a small pamphlet setting forth the properties of their new "Climax" resistance wire.

This wire has a high specific resistance, and possesses strength and toughness far in excess of the ordinary wires used for resistance work. It has nearly fifty times the resistance of copper, while German silver has only eighteen times, and ordinary steel wire about eight times the resistance of a copper wire of the same diameter.

The resistance of this wire varies slightly. One piece may

show fifty times the resistance of copper, while another will show only forty-eight times copper resistance. Its low temperature coefficient fits it for any use to which German silver can be applied and its high specific resistance renders it an economical substitute for ordinary steel wire for resistance work. Its mechanical properties render it available for rheostat work where German silver is utterly useless, on account of its brittleness caused by repeated heating and cooling.

The pamphlet contains tables of resistance and carrying capacity of this new resistance wire, which possesses the remarkable properties referred to above.

Swinging Tree Insulators.

The swinging tree insulator which is manufactured by the Western Electric Company is a device which will be thoroughly appreciated by the central station manager whose lines pass through trees. This insulator fully protects the lines from swaying branches without cutting the insulation and is readily hung by a wire twisted through the hole at the top. This loop of wire can be lengthened and adapted to a wide range of conditions. A good time of the year to inspect line wire is just before the trees begin to bud and blossom, for at that time it can easily be seen how near the wires approach the limbs and there are better opportunities for placing the tree insulator in an advantageous position when the view is thus unobstructed. These insulators can also be used to support arc light wires when passing under bridges, awnings, or iron roofs.

The Electric Storage Battery Co.

A new catalogue has just been issued by the above company setting forth the many advantages claimed for the chloride accumulators for central stations, isolated plants and traction work. The catalogue contains many illustrations of the various types and weights and prices of cells. A chapter on the use of the hydrometer and full instructions for setting up and using the chloride accumulators make the catalogue a handy reference book for anyone in charge of accumulators.

Mr. W. R. Garton.

The above named gentleman has severed his connection with the Central Electric Company and will shortly open an office in Chicago, devoting his entire time and attention to his own personal interests, as well as the representation of Eastern manufacturers. Mr. Garton has been well known in the field for a long time and during the past three and a half years has acted as the manager of the Central Electric Company's Railway Department.

Large Lundell Motor Contract.

The Sprague Electric Company, of New York, have secured the contract for motors to be installed in the new works of the John Stephenson Company, Limited, Elizabethport, N. J. This is a large and important contract and some 48 motors will be utilized, ranging from 3 h. p. to 40 h. p., mostly large size machines. The motors will be of the well known Lundell type and will be direct connected, belted or coupled to the latest types of wood working machinery. As is generally known, the Lundell motors are of the inclosed type and are admirably adapted for use in wood working machinery establishments where, of necessity, the atmosphere is filled with dust. Several large size Lundell direct connected exhaust fan outfits will also be included in the equipment. The plant will be one of the largest of its kind in this country and will be equipped exclusively with the Lundell motors.

Metropolitan Electric Construction Co.

This recently formed company has opened offices in the Commercial Cable Building, where its business will be under the care and management of Mr. W. B. McQuesten. It proposes to devote its energies chiefly to the installation of electric elevators and other machinery manufactured by the Sprague Electric Company, which has a strong representation in its control, and of which it is practically a department. It has also a large personal interest in it outside of the Sprague Company, which it is expected will contribute also to efficiency and economy of operation.

Recent Sales by the Ridgway Dynamo and Engine Co.

The Ridgway Dynamo and Engine Company, Ridgway, Pa., have recently made the following shipments: One 90 h. p. tandem compound engine to the Deadwood and Delaware Smelting Company, Deadwood, S. D.; one 125 h. p. simple engine to the Logan Consolidated Coal Company, Mattewan, W. Va.; one tandem compound engine direct connected to one 100 k. w. generator to the United States Iron and Tin Plate Manufacturing Company, Demmler, Pa.; one 200 h. p. simple engine to Newsam Bros., Kingston Mines, Ill.; one 175 h. p. simple engine to the Lackawanna Light, Heat and Power Company, Taylor, Pa.; one 50 k. w. belted generator to the City of Macomb, O. Besides the above shipments, the following contracts have been closed: One 50 h. p. simple engine to the Waterous Engine Works, Company, Ltd., Brantford, Canada; two tandem compound engines direct conected to two 150 k. w. generators to the Bucks County Railway Company, Doylestown, Pa.; one 250 h. p. simple engine and one 150 k. w. belted generator to the Berwind-White Coal Mining Company, Scalp Level, Pa.; one simple engine direct connected to 20 k. w. generator to the Schussler Brewing Company, Buffalo, N. Y.; one 35 h. p. simple engine to the Model Mill Company, Nashville, Tenn.; one 200 h. p. simple engine to the Phillipi Coal Mining Company, Philippi, W. Va.; one 125 h. p. simple engine to the Eldon Coal and Mining Company, Ottumwa, Ill.; one 150 h. p. tandem compound engine to the State of Arizona Improvement Company, Yuma, Ariz.; one 100 h. p. engine to the Ohio and Mississippi Coal Mining Company, Marion, Ill.; one 25 k. w. belted generator, Fessenden Manufacturing Company, Pittsburg, Pa.; one 40 k. w. belted generator, DuBois Iron Works, DuBois, Pa.

Henry R. Worthington's Triplex Pumps.

The triplex electrically driven pump manufactured by Henry R. Worthington, Brooklyn, N. Y., is different in several features from anything heretofore brought out, and marks a decided step towards the development of the theoretically perfect electric pump.

Two of these machines have recently been installed at the new station of the Brooklyn Edison Electric Light and Illuminating Company, for feeding the boilers (see Electrical Engineer, January 6, 1898; page 18). They are driven by specially wound low speed motors, the connection being made by a single reduction of cut spur gears; that is, the spur wheel carried on the pump shaft meshes directly with a rawhide pinion carried on the armature shaft. This does away with the counter shaft and high speed gears ordinarily used, and gives a neater looking, more compact, and practically quiet running machine. The air pumps and circulating pumps at this station are also electrically driven; the boilers are rated at about 2,500 h. p., and carry 165 pounds steam pressure. The fact that electricity should be used for the auxiliaries in preference to steam, is very convincing evidence of the growing popularity of the electric pump. Formerly it was thought that the electric current could only be used to advantage when steam was not available or had to be brought through a long line of pipe from some distant plant, but engineers have since learned by experience that no pumping installation should now be made without first considering the possible advantages of electricity for motive power, even where steam is readily obtainable.

The central stations have now extended their lines so as to put the electric current within the reach of nearly all large factories, and the use of electricity is daily becoming more general, especially for such work as can be done in the daytime. Such uses afford a central lighting station means of leveling the daily load line and obtaining a revenue from the costly generating machinery, which would otherwise at such hours be practically idle. The electrical companies appreciate this fact and are willing to supply electrical current during the daytime at very reduced rates.

NON-POLARIZING DRY BATTERY COMPANY, 625 Broadway, report an excellent demand for their O. K. dry battery. Orders are pouring in from all parts of the country, necessitating the employment of extra help as well as the installing of additional machinery in order to deliver goods promptly. The O. K. dry battery is adapted for all open circuit work and is claimed by the manufacturers to be superior to anything now on the market.

ADVERTISERS' HINTS

THE GENERAL ELECTRIC COMPANY illustrate several types of enclosed arc lamps. Durability, efficiency, artistic ornamentation, attractive proportions and easy manipulation are some of the characteristics claimed for them.

KEYSTONE ELECTRIC COMPANY, Erie, Pa., advertise their type "G" multipolar generators and motors in capacities from 1 to 7 kilowatt slow and medium speeds. They have ironclad armatures, steel poles and field ring, self-oiling bearings and may be bolted to the wall or ceiling.

THE UNITED CORRESPONDENCE SCHOOLS, 154 Fifth avenue, New York, again call attention to their course in electrical, mechanical, steam, civil, and sanitary engineering. It costs something less than seven cents a day to enroll.

H. B. COHO & COMPANY, St. Paul Building, New York, have added "Van" gas engines, "American" rheostats and "Translucent" fabric to their list of well known specialties.

J. P. WILLIAMS, 39-41 Cortlandt street, New York, advertises "Paragon" power motors of 1-12 and 1/8 horse-power, wound for storage batteries, and also a full line of latest type ceiling desk and wall fans.

THE DIAMOND ELECTRIC COMPANY, 1202 Fisher Building, Chicago, Ill., advertise the Scheeffer wattmeters and transformers and mention some of their respective points of merit.

THE AMERICAN STOKER COMPANY, Garfield Building, Brooklyn, N. Y., state the guarantee, a very broad one, under which they sell their automatic stokers.

THE AMERICAN ELECTRICAL HEATER COMPANY, 197 River street, Detroit, Mich., show another variety of their apparatus.

THE GOLD STREET CAR HEATING COMPANY, Frankfort and Cliff streets, New York, say their heaters combine the highest efficiency with the greatest economy and are the acme of simplicity.

THE McCAY-HOWARD ENGINEERING COMPANY, 106 East German street, Baltimore, Md., are advertising the Ries regulating socket as a means of saving current and lamps.

THE RUSHMORE DYNAMO WORKS, Jersey City, N. J., cite the advantages of their new multi-voltage system as applied to any multipolar machine. This system is in operation at the company's factory and inspection is invited.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., are headquarters for all iron goods used in electrical line construction, such as lag-screws, pole-steps, cross-arm braces, etc. These are all carried in Chicago stock and prompt shipments may be made at any time.

WHITMAN & COUCH, 196 Summer street, Boston, say that as "the proof of the pudding is in the eating" it is a first-rate plan to try their telephone apparatus and place your exchange on a paying basis.

FRED. J. CROSS, 310 Mooney-Bristane Building, Buffalo, N. Y., may be consulted on all matters pertaining to electrical engineering.

KIELEY & MUELLER, 7-17 West Thirteenth street, New York, manufacture a great number of steam specialties, among which may be noted steam traps, pressure and damper regulators, noiseless and tight back pressure and relief valves especially adapted for electric and high pressure plants.

THE UNITED ELECTRIC IMPROVEMENT COMPANY, Alleghany avenue and Nineteenth street, Philadelphia, offer their incandescent lamps in competition with any others on the market.

THE MICHIGAN PIPE COMPANY, Bay City, Mich., are ready with a new catalogue descriptive of their creosoted wood conduits for underground wires. They are said to be practically indestructible.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, say of their cable: "It is as reliable as a galvanometer, as infallible in action, and is continuously thermostatic." Their descriptive matter may be had on application.

THE DETROIT SWITCHBOARD AND TELEPHONE CONSTRUCTION COMPANY, Majestic Building, Detroit, Mich., manufacture telephone apparatus of all kinds and contract for and build telephone plants and toll lines. They submit a list of plants they have installed, and illustrate a switchboard and some types of instruments.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., furnish switches, switchboards, panel-boards and electrical specialties. They reproduce their voltmeter switch. Their catalogue for the asking.

THE WESTINGHOUSE ELECTRIC & MFG. COMPANY, Pittsburg, Pa., state their reasons for advertising.

THE LECLANCHE BATTERY COMPANY, 111 East 131st street, New York, advertise the "Gonda" battery as the standard open circuit battery of the world.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, Ill., advocate the purchase of telephones that not only talk well but look well also. They invite requests for photos and prices.

L. A. CHASE & COMPANY, Boston, Mass., publish a testimonial from the Salem Electric Lighting Company commendatory of the Elden alternating circuit breaker.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., recommend their system of mechanical draft as the most economical and satisfactory in the production of steam.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., advertise the "Columbia" rail bond, which has a contact equal to seven times the section of the rail.

THE NATIONAL CARBON COMPANY, 620 Highland avenue, Cleveland, Ohio, manufacture a complete line of battery cells and specialties besides the carbons bearing their well known name.

HART & HEGEMAN MFG. COMPANY, Hartford, Conn., call attention to their 10 ampere, double-pole snap switches.

SIPE & SIGLER, Cleveland, Ohio, the successors to the Willard Electric and Battery Company, have completed improvements in their factory to facilitate the rapid and extensive manufacture of the Willard battery. They make a special offer to those desiring to make a scientific test of their cells, the full terms of which may be found in their advertisement.

THE CENTRAL ELECTRIC COMPANY, 173 Adams street, Chicago, having finished their inventory find their stock of supplies and specialties to be very large and complete, and are, therefore, able to fill all orders promptly.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 173 South Canal street, Chicago, Ill., advertise long distance and exchange telephones equipped with their patented adjustable arm and heavy output nickeled generators. They also advertise pay station signs for independent companies at 80c.

HAMMACHER, SCHLEMMER & COMPANY, 209 Bowery, New York, advertise telephone box hardware and wood and metal working tools.

THE ELECTRICAL EXCHANGE, 166 South Clinton street, Chicago, offer some excellent bargains in dynamos, arc lamps and transformers of standard makes.

WESTERN NOTES

MESSRS. SIPE & SIGLER, manufacturers of the Willard storage battery, have recently filled orders for the Western Union Telegraph Company for 120 "Willard" storage cells for Hoboken, N. J., 40 cells for Scranton, Pa., 30 cells for New Haven, Conn., 25 cells for Newark, N. J., and 343 plates for Ravenna, N. Y.

THE UPTON MIDGET is already a very popular specialty. The small size, light weight and tasty appearance of this long burning arc lamp makes it a very desirable arc lamp for inside work, while its positive and steady action and general reliability make it a popular lamp for all places where long burning is required. The Electric Appliance Company, Chicago, will be glad to send their latest circular on this specialty on application.

THE BRUNT REGULATING SOCKET for regulating the candle power of incandescent lamps, now being introduced by the Central Electric Company, is meeting with a very ready sale. These goods have forced their way to the front as the best articles of the kind yet produced for regulating the candle power of incandescent lamps.

CHICAGO.—The General Electric Company is building 36 additional 175 h. p. motors for the Metropolitan West Side Electric Elevated Road.

NEW CIRCULAR OF THE WALKER COMPANY.—The Walker Company, of Cleveland, Ohio, and New Haven, Conn., have just issued circular No. 1,063, which contains a very exhaustive treatise by Prof. S. H. Short on "Electricity as a Motive Power on Elevated Railways." The article is profusely illustrated and contains many valuable curves and tables, such as the comparative cost of steel and copper feeders and data of actual tests of train performances on elevated roads

CALENDAR OF THE WAGNER ELECTRIC MANUFACTURING COMPANY.—The Wagner Electric Manufacturing Company, St. Louis, have issued a very handsome calendar which illustrates in the words of the company "A few things we make." Among these should be mentioned the d. c. generators, transformers, a. c. motors, fans, switches, switchboards, instruments and d. c. motors.

NEW YORK NOTES.

THE MONTAUK THERMOSTATIC CABLE.—The interest manifested in the new thermostatic cable of the Montauk Multipolar Cable Company, 100 Broadway, New York, is shown by the large number of inquiries received by that company from all parts of the country. Samples have been requested from all branches of the electrical trade, such as telephone and telegraph companies, supply houses, contractors, fire alarm companies, central stations, and electrical works in general. This company are mailing sample cards of their new cables to any address upon application.

PELTON WATER WHEEL COMPANY.—The Pelton Water Wheel Company report a large run of business for the last two months of 1897. Among the more important shipments may be mentioned: Wheels, governors and accessories covering a 2,000 h. p. plant for San Rafael Paper Mills, Mexico; six wheels for various other localities in Mexico; a 1,200 h. p. wheel with accessories for an electric transmission plant for Petropolis, Brazil, this being a duplicate of their former plant; an electric power transmission plant for Prujillo, Brazil; seven wheels with governors, pipe lines and accessories to operate tea and coffee plantations in Java; three wheels for the Ruby Mines in India; two 600 h. p. wheels for operating mills in Tasmania, Australia; three 1,000 h. p. wheels with governors and accessories, direct connected to Stanley generators, for the Yuba Power Company, Marysville, Cal.; one 200 h. p. wheel for operating the mill of the Dexter Gold Mining Company, Tuscarora, Nevada; nine wheels for various mining operations in California. A large number of orders are in hand, making the outlook for the present year very encouraging.

AFFIDAVITS OF THE FRANKLIN H. KALBFLEISCH COMPANY.—In reply to a statement made by a competitor that "No acid manufacturers are now making sulphuric acid or oil of vitriol from Sicily brimstone," the Franklin H. Kalbfleisch Company, New York, have published a number of affidavits, each one sworn to by officials before a notary public, from which the following extract is taken: "Every pound of sulphuric acid or oil of vitriol manufactured by the aforesaid factory in Brooklyn, N. Y., is made strictly from Sicily brimstone;" a similar statement regarding the output of the Waterbury, Conn., factory, and others of a similar nature.

DeVEAU & COMPANY, the well known manufacturers of telephones, electrical supplies, etc., are leaving their old quarters on Frankfort street, and after February 1 will have their office and factory at 27 Rose street, where they will enjoy increased facilities for the large and growing trade which they have built up.

MR. W. S. TURNER, M. S., consulting and constructing electrical and mechanical engineer, has removed his office from No. 1 Nassau street to 120 Liberty street, room 1,000. Mr. Turner has had a large and varied experience in consultations, specifications, plans, estimates, tests, reports, supervision and purchasing in connection with electric traction, electric lighting, power transmission and steam engineering. He has been connected during the past ten years with the Westinghouse Electric Light Company, Edison Electric Light Company, and the Woodbridge & Turner Engineering Company. Mr. Turner is a member of the A. I. E. E. and a graduate of Cornell University.

THE GENERAL ELECTRIC COMPANY have just issued a very handsome calendar which embodies the commendable feature of a moonlight schedule, arranged for New York State, giving for each day in the year the hours for lighting and extinguishing the lamps. The hours for lighting are marked in red and for extinguishing in black, and when no lamps are required, the space is marked "No Light." A calendar embodying such useful functions is always welcomed by the station engineer and superintendent.

HON. GARDINER C. SIMS, of the Vulcan Foundry, Providence, R. I., was a visitor to New York City last week, attending the meeting of the National Foundrymen's Association. He also attended the meeting of the American Institute of Electrical Engineers.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

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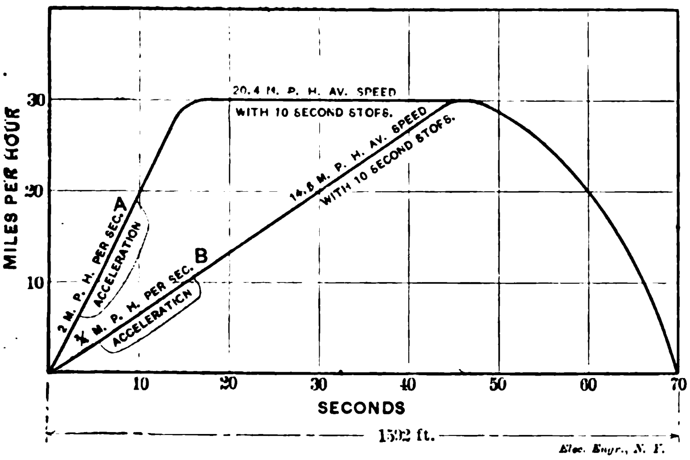
ELECTRIC TRANSPORTATION

Some Notes on Electric Car Acceleration.

BY J. R. CRAVATH.

IN consideration of the recent interest that has been aroused in the possibilities of very rapid train acceleration with electric motors it may not be out of place to call attention to the fact that the acceleration used in common daily electric street railway practice is excellent and much more rapid than in any other branch of railroading with the one exception of the cable road.

Thus, for example, a 15,000 pound single truck electric street car, of a type familiar to the writer, having two 25 horse-power motors geared to run 16 to 18 miles an hour maximum speed can be started and brought up to speed on a level in about 12 seconds on a dry or clean track. This is ordinary good practice and represents an acceleration of 1½ to 1⅓ miles per hour per second. This is not so very far below the rate of 2 miles per hour per second acceleration which has been recently proposed and experimented with for elevated and suburban work. As said before, this 1⅓ to 1½ miles per hour per second acceleration may be called common good practice on street railways. I may add also that a great many motormen try to do much better than this, but the results in acceleration are usually not in proportion to the power used owing to a number of causes,—



CAR ACCELERATION CURVES.

but that is another story. Such a 12 second start with the kind of car mentioned can be made with a maximum current when the motors are thrown in multiple of 60 to 70 amperes and does not abuse the ordinary 25 horse-power railway motors used now on such cars. There are frequently days, however, during the winter season in our large cities when mud and snow make it difficult to accelerate as quickly as this, because of a slippery track.

On steam and elevated roads the rails are always clean except during sleet storms and the proposed rate of 2 miles per hour per second is no doubt feasible if the current is applied to the motors without jerk and the greater part of the weight of the car is put on the driving wheels.

Whether such a rapid acceleration will be worth all that it will cost to get it is the great problem to be decided to-day by those considering the equipment of elevated and steam suburban lines with electricity. That the outlay will be far beyond anything heretofore known in the electric railroad field all will admit, but it is also evident that such an acceleration when carried up to speeds of 30 to 50 miles an hour will give a rapid transit schedule which will leave far behind any present schedules. It lies with the engineer to properly calculate the outlay, and with the directors and stockholders to judge whether the increased receipts are likely to justify the expenditure. Few realize what an enormous investment a system providing for such a rapid acceleration would involve. I will not attempt to analyze in a few sentences problems that should properly take weeks of calculation, but some idea can be had of the magnitude of the proposition when it is seen that the rate of acceleration proposed (to 30 miles per hour in 15 seconds) is about three times the common practice on the elevated roads of Chicago. As the heating of the motors is according to C^2R, the amount of heat generated during acceleration in the motors of a road operating with the fast acceleration proposed would be three times that generated in the motors used on the two West Side electric elevated roads in Chicago. Experience has demonstrated the advisability of heavier equipment on those lines, however, and it would not, therefore, be safe to count on less than four to five times the motor capacity now employed on the motor cars of those roads if they were to be changed so as to permit the proposed rapid acceleration with the same maximum speed as before. This is one important item. It is partly offset by the fact that the faster acceleration, and, consequently, faster schedule would reduce the number of trains necessary to perform a given service. The power required during acceleration of each train being increased 300 per cent. it would not be safe to count on a power plant capacity less than double that at present used, and a still greater increase of feeder lines, although the average load would be light. Furthermore, such acceleration necessitates the use either of the Sprague multiple unit system or a heavy motor car pulling only one trailer. The latter plan will not take care of rush hour traffic without interference of trains. The Sprague system is admitted to be of low electrical and mechanical efficiency, and is, therefore, not only costly to operate on the basis of kilowatt hours per car mile, but, furthermore, means a heavy investment for the motors, air pumps and controlling devices necessary on every car. The electrical repair and inspection department must also be increased several hundred per cent. with this system to take care of the numerous motors and other appliances. This is not said to discredit the Sprague system, but simply to point out another large item of expense that must be figured in on the rapid acceleration scheme.

The question then to decide is whether all this extra investment and extra operating expense is likely to be justified by the results in passenger traffic.

On this I will not pretend to say. The accompanying curves have been plotted diagrammatically to determine what effect on the schedule an acceleration to 30 miles per hour in 15 seconds would have on a road where the practice is now to accelerate to 30 miles per hour in 45 seconds. Curve A shows the rapid acceleration and gives an average speed with 10 second stops and stations 1,592 feet apart of 20.4 miles per hour. Curve B shows the slower acceleration and gives an average speed of 14.6 miles per hour, the stops and braking curves being the same in both cases. This is certainly a difference it is worth paying something to get, as it amounts to about 25 per cent. in running time, and that will attract a good many passengers.

There are many other phases of the question that I will not take space to consider here. The engineer of any rapid transit line now considering the adoption of electricity has many complicated problems to solve.

Apparatus For the London Underground.

The General Electric Company has received orders from the British Thomson-Houston Company, Limited, covering the complete locomotives for the Central London Underground Railway. The original contract between the two latter companies included, with the special gearless motors and other electrical equipment, 32 locomotives for this important underground system, but, these, it was supposed, would have been built in England. The decision to confide the construction of the locomotive cabs and trucks, as well as the electrical equipment, to the General Electric Company is dictated by the desire to have the locomotives built complete under the same supervision.

The locomotives will each weigh about 45 tons, and will be

equipped with a total of 800 h. p. in motors. The trains to be hauled will be made up of five cars, giving a total load of 150 tons, 10 tons heavier than the ordinary Manhattan Elevated train. The schedule speed will be 15 miles an hour.

The diameter of the tunnel being 11 feet 6 inches only, motor cars could not be used. The entire electrical equipment will, therefore, be placed on locomotives which will probably resemble in appearance those in use on the Manufacturers' Railroad in New Haven, Conn., and on the Hoboken Shore Road, Hoboken, N. J.

Municipal Ownership of Street Railways in Massachusetts.

A Report Against it by a Special Investigation Committee.

UNDER an act of the last State Legislature a committee consisting of Charles Francis Adams, chairman, and ex-Congressman William W. Crapo, of New Bedford, and ex-Mayor Elihu B. Hayes, of Lynn, has been investigating the relation of street railways to municipalities. Mr. Adams, who wrote the report, subject to approval, went to Europe, and the others visited about twenty cities in the United States and Canada. Some of the evidence taken appeared at the time in the columns of The Electrical Engineer. They now report against the municipal operation of street railways, but are also of opinion that municipal ownership of tracks, with operation by a corporation is preferable to the present system of private ownership and operation which prevails for the most part of the United States. They were also instructed to consider the taxation of street railways. Their conclusions are embodied in two bills. One provides for municipal ownership of tracks. The other changes the system of taxation. Whenever a street railway company has paid 8 per cent. or over for the year, it must pay into the State treasury, in addition to its franchise tax, as much as it has paid over 8 per cent. This tax is to be distributed to the cities and towns according to the trackage within their limits, instead of according to the residence of stockholders, as is now done. Local taxation is to be a proportion of the gross receipts by a sliding scale according to receipts per mile of track operated by the company in the city or town compared with the total length, as follows:

In case of companies whose annual gross receipts per mile of track operated are $7,000 or less, 2 per cent. of the total annual gross receipts; in case of companies whose annual gross receipts per mile of track operated are more than $7,000 and less than $14,000, 2¼ per cent. of the total annual gross receipts; in case of companies whose annual gross receipts per mile of track operated are more than $14,000 and less than $21,000, 2½ per cent. of the total annual gross receipts; in case of companies whose annual gross receipts per mile of track operated are more than $21,000 and less than $28,000, 2¾ per cent. of the total annual gross receipts; and in case of companies whose annual gross receipts per mile of track operated are $28,000 or more, 3 per cent. of the total annual gross receipts. The tax provided by this section shall be in addition to the taxes now provided by law.

One provision is that all amounts paid to cities and towns under the provisions of the act shall be treated as a separate fund, and shall be applied to the construction, repair, and maintenance of the public ways within such cities and towns.

The report shows how the idea of regulation by means of private competition, as in the case of railroads, was followed for a long time, but the times have changed. "The modern practice, as well as theory, is the consolidation of lines in a given municipality under one ownership, that ownership to be held to strict accountability as a recognized public agency." Economy of management will result. "Single ownership of some sort, public or private, may therefore be accepted as a condition of the problem." The report discusses the devotion of streets to car traffic. There are three distinct lines of treatment of the relations between the street railway and the municipality, says the report. The first is the outcome of the original idea of private ownership of both track and vehicle. This complete private ownership exists in both America and Europe. The second line of development recurs to the original principles of ownership, that the street and its pavements are public property, but the vehicles which run upon them belong to private parties, whether individuals or corporations. No distinction is made in the character of the pavements as to material. The municipality concedes to a company the right to run vehicles on a specially prepared part of the pavement, exclusively. In this case the vehicles and motive power only belong to the private company. The third line of development is in the direction of full public ownership—what is known as municipalization.

The report then speaks of the situation in different places in Europe. Private ownership is most common in America. The second system is most common in Germany. In Great Britain there is a strong tendency towards municipalization. Of the system in Massachusetts it is said: "As a working machinery for the daily accommodation of vast numbers of persons, the street railways of the commonwealth fulfil their function quite as well, with as little friction and at as reasonable a cost, as any other similar machinery elsewhere which the committee has had an opportunity to study." The committee ridicule the foolish yarns of municipal advocates of the wonderful working of other systems in foreign cities. They could not find such results from their investigations.

The committee say that the street railways of Massachusetts have cost much more than they could be replaced for, and that it is more than probable that there have been instances of over-capitalization through questionable processes of financiering, but these incidents are inseparable from an unusually rapid development along new lines. The fundamental question is not merely one of greater or less expenditure; but what would have been lost if the expenditure had not been incurred must also be considered. Statistics concerning Boston, Glasgow, and Leeds show that Boston street railways carry many more people according to the population. Massachusetts is far in advance of any portion of Europe in distributing urban population over a wide area. This has been brought about in an extraordinarily short time, not by "drastic, radical legislation," but by the energetic expansion of the railway system. It remains to be proved that the costly experimenting has not been worth what it cost.

A more fixed tenure of franchise was one of the two points for the committee to consider. The report says on this point:

The substitution for the present indefinite concessions of a specific and binding contract, covering a fixed term of years, setting forth the rights and obligations of the parties thereto, and containing a rule of compensation for the purchase of the property in case of failure to renew, at once suggests itself as a measure to reform; and yet it was very noticeable that, in the course of the protracted hearings before the committee, no such change was advocated by the representatives of the municipalities or of the companies, nor, apparently, did the suggestion of such a change commend itself to either. Some amendments in detail of the existing law, and partial measures of protection against possible orders of sudden, ill-considered, or aggressive revocation, were suggested; but it was evident that, while the municipalities wanted to retain as a weapon the right of revocation at will, the companies preferred, on the whole, a franchise practically permanent, though never absolutely certain, to a fixed contract tenure for a shorter term, subject to the danger of alteration at every periodic renewal.

The committee question the wisdom of disturbing methods which work well in practice, even if they are illogical. Furthermore, in Europe the fixed period operates as a serious check on enterprise. Strong inducement exists to get the largest profit possible out of the time conceded without increasing the value of the system, which must again be subject to negotiation for another fixed contract. In the American cities visited by the committee the matter of a franchise has been productive of dissension, poor service, scandals, and unhealthy political action. "In fairness, the committee found itself forced to conclude that the Massachusetts franchise, which might perhaps not improperly be termed a tenure during good behavior, was, in its practical results, best."

The report takes up the complaint, on one hand, in behalf of the public, that too great privileges with too few responsibilities have been given to the railway corporations; and, on the other, the complaint of the corporations that they are insufficiently protected against the public. They conclude that the matter is one of local concern, in the main. The municipalities must judge of the use which they will permit to be made of their thoroughfares; the corporations must judge whether they will accept the grants of location with the degree of protection which is afforded. It is not for the commonwealth to prescribe the terms on either side. Recommendations on the matter are these:

On the one hand, they (the committee) would grant the local

authorities explicit power hereafter to impose such terms and conditions as they deem the public interests demand, on original grants and locations in the localities over which they have jurisdiction; while, on the other hand, they would protect companies whose tracks have been already located from new and perhaps unreasonable conditions sought to be imposed in grants of alterations and extensions, which may be called for, not less for public convenience than by corporate interests.

Taking up next the question of street railway development through regulated private ownership, the report says:

The chief objection to it is obvious—it necessarily involves a divided control of streets, resulting in continual jealousies, misapprehensions and disputes. While, because of its apparent simplicity, as well as from the analogy of the steam railroad, it naturally suggested itself in the early and experimental stage of street railway development, it certainly does not now commend itself as a permanent or scientific arrangement. Even should it be continued indefinitely, the committee is clearly of opinion that it would be conducive to a better state of affairs were the municipalities to assume full control of the streets, meeting all charges for paving and for street cleaning, and receiving therefor from the companies a net annual money payment in lieu of work in kind.

The committee prefer, instead of private ownership, a system known somewhat in Great Britain, but better known in Germany—"a system under which the municipality both owns and controls the whole surface of its streets, whether paved with other material or with iron, and leases to a private company the right to run vehicles over prescribed routes on tracks therein specially provided."

The third line of railway development—municipalization—is then considered. It is said to be yet in the experimental stage. The tendency towards it in Great Britain is pronounced, and it is in practical operation in Glasgow, Leeds and many other places. "So far as development, activity and material and scientific appliances and equipment are concerned, apart from permanent way and track surface, the American street railway is so far in advance of any to be found in Great Britain as not to admit of a comparison. . . . America has experimented at immense cost. . . . while Europe has patiently waited, and is to-day rapidly and quietly appropriating the results for which we have paid." The report, as might have been expected, denies that European experiments have been demonstrated to be successful, and says:

So far from being a demonstrated success, it may, on the contrary, be confidently asserted that nowhere, as yet, has the experiment of municipalization of street railways been worked out to any logical and ultimate results whatever, nor can it be so worked out for at least a score of years to come. Even then, political habits, social traditions, and material and economical conditions vary so greatly and enter to so large an extent into the problem, that it will not be safe to infer that what may have proved safe and practicable in one community is either practicable or safe in another. At the present time the municipalization of the street railways is not accepted as by any means indisputably desirable in Great Britain, while in Germany it is regarded unfavorably.

Municipal Power Over Franchises in Illinois.

Street railway interests of Illinois, which met at Chicago on January 5 as a State association, have prepared a bill for submission to the Legislature designed to make the life of every street railway franchise in the State ninety-nine years. The bill was prepared by C. L. Bonney, of the Chicago General Electric Railway Company, who takes the ground that the street railway companies, being incorporated under the constitution and statutes of the State, the Legislature can extend the franchises. As the Federal constitution recognizes only States and counties, a municipality, he claims, has nothing to do with the granting or extending of the franchise, the municipality having only the power of enforcing police regulations as to the running of cars through the streets. Mr. Bonney also urges that coming legislation be so framed that an appeal from the State Supreme Court to the Supreme Court of the United States will be inevitable. It is reported that immediately upon the conclusion of the present special session of the Legislature, Governor Tanner will be asked to call another to take up street railway affairs.

MUNICIPAL AFFAIRS

Public Control, Ownership or Operation of Municipal Franchises?—VI.

With Special References to Electric Lighting.*

By R. R. BOWKER.

(Vice-President and General Manager New York Edison Co.)

IN 100 American cities of 30,000 population and over recorded by the National Electric Light Association, five have municipal plants; and of 450 smaller cities, fifty-three have municipal plants; or a total of 493 cities with private and fifty-eight with municipal plants. The figures of price for street lighting for the standard arc lamp range from $64.75 in Dubuque, on moonlight schedule, and $68.52 costs (direct expenses only), all night, in Detroit's municipal plant, to a price of $156.95 in Fall River, Mass. The New York report shows prices to be $146, $164.25 and $182.50, nominally for 1,200 candle power lamps; in fact, the first are the standard arc lamps registered elsewhere as 2,000 candle power, the second are the same lamps under exceptional circumstances, and the third are pairs of lamps, not single lamps, supplied from the Edison system. The standard arc lamp using 450 watts in the arc (ten amperes supplied at forty-five to fifty volts) is usually called a 2,000 candle power lamp, but this in New York is rated officially as "at least 1,000 candle power" and is entered in the National Electric Light Association reports as 1,200 candle power, though in other cities counted 2,000, while the lowest standard lamp of 300 watts 6.8 to 7 amperes at forty-five to fifty volts), in use in Brooklyn and elsewhere, is counted as 1,200 candle power.

DATA OF COMPARISON.

The facts as to municipal industries in the chief cities and from the several countries show such range and diversity in method and results that conclusive generalizations are not easy. Each advocate can indeed find individual facts in defense of his own views. It is the usual device of socialist writers to emphasize the ills of an existing system, and to assume that in their new Utopia all would go well. This has been true of much of the argument for the municipalization of industries. The wiser course is perhaps to build from existing conditions, by eliminating the bad features and promoting the good features of an existing system, unless the evidence is conclusive that another system would be in all or in most respects better. In this belief I shall state my own conclusions from these data, and from my personal experience.

It is, of course, not more practicable to reconstruct existing systems altogether on these lines, than it is to remake altogether an existing city in the light of present knowledge and modern methods. Yet Paris and other continental cities have been largely reshaped within this generation, and the trend of progress will be, I think, in the directions indicated. Nor would municipalization be possible with justice, except in view of existing conditions and investments. It is not just, for instance, that a municipality should take over private industries by right of eminent domain or legislative enactment, at the appraisement value merely of the existing plant. The electric lighting industry for example, though not yet 20 years old, has shown extraordinary development and changes, and a large part of its actual cost has been in patent rights, engineering expenses and replacements of machinery or distributing plant. Mr. Edison's original two-wire underground system in New York has been entirely replaced by his improved three-wire system. To write off such replacements is not always practicable in industries which have not reached the paying point. Expenditures on this account are legitimately a part of the actual investment, and they must be taken into account if municipalization is not to mean confiscation. It should be repeated that a fair comparison between a private company and a municipal industry

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the business cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

requires that the private company shall have, as in Berlin, the advantages usually associated with a municipalized industry.

THE PREFERABLE SYSTEM.

The modern city, it seems to me, should own and control its streets, including, as far as possible, both sub-soil and surface facilities of distribution; should itself provide sewerage and water supply, but should leave to private companies the operation of industries which involve manufacture or complex administration. The city should receive adequate rent for the use of its street facilities, should obtain for the people the social increment by limitations of profit or price, and should give to the private companies every economic advantage of tenure, centralization, etc., possible to a municipalized industry. Charters should be granted for a specific period say of 25 years, with renewals at the option of the municipality upon similar terms, so that satisfactory service would insure a continuing franchise. With the proviso, as in the New York ferry leases, that the new lessee might take over the operating plant at an appraised valuation, this would invite and safeguard the investment of private capital without undue risk. Provision should be made, as in Paris, to secure for the public the most modern improvements and consequent reductions in cost. The city should have its own services, as street lighting, at cost, this including, of course, investment as well as operating charges. With such safeguards, one gas company and one electric light company, competing with each other, and one surface railway company affording facilities for transfer and competing with an underground or elevated system, would give the best economic results. Parallel grants should be made only on the certificate of an authority like the Massachusetts Gas Commission or the New York Railway Commission that they would be for the public benefit. If the grant is not exclusive for the whole city, it should be limited to specified sections.

The city should provide under its main thoroughfares an accessible subway tunnel, as a modern building has in its cellar space for its working apparatus. This sub-street, such as London now has and Stockholm has planned, should give easy access by manholes to the sewers, and should provide space for water mains, gas pipes, electric conductors and other services, both for trunk lines and for local distribution, with access to buildings by side recesses between each two buildings. In other streets a distributing subway system of ducts, preferably on each side to prevent displacement of paving, should be comprehensively planned for water, gas, electricity, etc., with house access at the curb between each two buildings. Rent for these facilities, covering construction interest, maintenance cost and a license for such use of street facilities, should be charged by the city to its own water department, for instance, as well as to the private companies. Where a special system requires private construction, the street license but not the construction interest should be charged. The city might also own and lease the track for a surface railroad as in Toronto, as well as provide a rapid transit tunnel, as is proposed in New York.

An honest and efficient municipal inspection should protect the interests of the citizens. Actual tests should be made from time to time and the results published. Meters should be tested by municipal inspectors on demand of any consumer, as in London, the company paying the charge if the meter is within and the consumer if it is without the legal requirements. Under these conditions the public should get the surest and best service at the lowest price, the few advantages of a municipalized industry with the many advantages of a privately managed industry.

ECONOMIC OBJECTION TO MUNICIPALIZATION.

The first vital economic objection to municipalization is on the score of cost. Economy is closely associated with the progressive management necessitated in private enterprise. A public body does not get its work done as well or as cheaply as a private corporation. The mixture of politics with business is demoralizing to both. Government plants are apt to be "behind the age." The United States government, I have been told, exhibited at Philadelphia in 1876, and again in Chicago in 1893, a cartridge-making machine which private manufacturers had superseded in 1871. The electric lighting plant installed at Manchester in 1893 was three years behind date at that time. The cost of government work is notoriously greater than that of private work. Ships built in the navy yards are known to take longer to build, to cost more and often to be less satisfactory than those built by private contract. In New York the city charges to private companies $8 for the first square yard and $4 for each additional yard for repaving granite block on concrete foundation, and the charge is defended as practically the cost to the city. The same work was done by a private corporation for the city at $2.50 with some profit, and a recent job of which close and complete record was kept cost exactly $2.02½ per square yard. The Court House in New York and the Capitol at Albany are notorious examples of the waste of public moneys in public work too often invited by our political system.

A municipalized industry is at correspondingly serious disadvantage as to management. A modern city government, however highly organized, attempts too much when it attempts everything. While the whole trend of industrial progress is toward consolidation within the same industry, it is toward a differentiation of different industries. A private corporation usually makes contracts for work outside its immediate field, because a specialized organization can do better in any specific work than a general organization. Asphalt paving, for instance, is done for all our cities at best advantage by the Barber and other asphalt companies, which do only this one thing. Contract work in the best private hands safeguards a public employer as no other method can—which is in itself the strongest argument against the municipalization of specialized industries. The Brooklyn Bridge railway, cited as proof that a municipality can operate a railway, was, as unfortunate Brooklynites know to their cost, disastrously managed, and the crush at its terminals was dangerous to life, until a commission of experts trained in the service of private companies devised remedies. The contrast between American and English railways, private corporations, and German railways, state organized, is in point; the Pennsylvania and the New York Central systems are recognized as foremost in the world. The Italian government after "nationalizing" its railways organized two private companies to take over and operate them. In England the private telephone company's "centrals" have taken over nine-tenths of the business, and a consolidation of the government and the private system is probable. In fact, the public service fails to assure the adequate salary and permanence of tenure necessary to retain concentrated and continuous directive ability of the highest order, although the public distinction of office-holding in part offsets the lower salaries in public employment. Many great corporations in New York pay their executive as high or higher salaries than that of the Mayor of New York, even under the new charter, and this high payment for brains is not at the expense of good payment for wages. Successful direction means an increase of business which gives wider employment to more men at better pay.

A municipalized industry, further, is under constant political pressure to pay wages higher than the market rate. The Trades Unions, indeed, favor municipalization largely because they consider that this would involve better wages. On the contrary, nothing could be more demoralizing in the actual labor market, nor more destructive to the legitimate influence of trade organizations. Municipalized industries would not be sufficient, short of entire socialism, to establish the market rate of wages. If municipal industries should pay twenty-five cents a day more than private industries, there would be a rush toward the municipal industries. Men would be induced to pay that, or a part of it, for a place, and would become the easy prey of designing politicians or corrupt superintendents. Such an increase of wages in a force of 1,000 men would mean $75,000 a year, with enormous possibilities of personal corruption and public demoralization beyond anything at present known. It is said that the postal, police and fire services have been kept "out of politics"; as a matter of fact, these classes, largely through their benefit associations, exert an enormous influence at Washington and at Albany, particularly in pressure to raise wages; and in the recent New York election one political "boss" appealed specifically to the interests of these special classes for support. Even under better municipal conditions, as in England, it has been found most difficult to preserve discipline in a municipalized industry, because of the pressure of politicians to reinstate discharged men, as I was personally told in the municipal electric lighting station of a great English city.

FISCAL RELATIONS OF MUNICIPALIZATION.

It has been urged as an objection that private corporations are too often "extortionate monopolies," robbing the people of their right to the social increment. This is in part, and in some

cases, true, but it is an objection that can be met in a better way than by municipalization. It is evident that the trend in the industries cited is toward consolidation, but it is true also that a consolidated company usually reduces prices by virtue of diminished cost for the business motive of increasing consumption and profit.

Municipal Socialism.[1]

BY FRED DE LAND.

THE mayor of Des Moines, a city having a population of 75,000, is the Hon. John MacVicar, who was recently elected president of the League of American Municipalities at the Columbus convention.

For several years the city of Des Moines had paid the sum of $126 yearly for each arc lamp of 2,000 candle power used in street illumination. Soon after his election, Mr. MacVicar started a movement to secure a more favorable contract for the city, and to strengthen his claim for a reduction in rates, secured from various sources official data regarding prices paid by other cities for street illumination, and what the actual cost is where municipalities own and operate the lighting plant.

As there are three local lighting plants in Des Moines, several conferences were then held with a view to the city purchasing one of the three; but a prohibitory price having been placed on the property, negotiations ended and the mayor began to look elsewhere. Then the engineering firm of McCaskey & Holcomb made a proposition to build, within six months from date the contract was signed, an acceptable modern lighting plant for a sum representing about two-thirds the actual cash investment in a local plant of similar capacity, as follows:

To build a lighting plant complete for supplying 500 arc lamps of 2,000 candle power and 1,000 incandescent lamps of 16 candle power, for the sum of $105,385; the city to furnish a suitable lot on which to erect the station; payment to be made as follows: $60,385 on completion of the plant; $25,000 one year after completion, and $20,000 two years after completion, the engineering company to retain full possession of the plant until the final payment is made, and also to receive from the city the annual sum of $32,500, in equal monthly installments, for the period of two years, to compensate the engineering company for supplying 500 arc lamps for all night and every night street illumination; this being at an average cost to the city per arc light of $65. The city also to carry during those two years not less than $20,000 of fire insurance on the station, and not less than $50,000 of tornado insurance on the entire plant.

The question of municipal ownership being submitted to the voters at a special election, it was carried by a majority of 2,416 in a total vote of 5,176 and the proposition above outlined was accepted and the mayor authorized to sign and deliver the contract. At the previous regular election the total number of votes cast was 13,000, showing that less than one-half the usual number of voters felt sufficiently interested to cast a vote.

As the mayor was signing the contract a taxpayer endeavored to prevent the action, but being defeated he then petitioned the courts for an injunction restraining the city from carrying out its terms of the contract, and the matter is now being argued in the courts. Until a decision is delivered nothing further will be done in building a municipal plant.

But when the contract for lighting the streets at the old rate of $126 expired, the mayor issued an edict based on the authority conferred in an ancient ordinance, that henceforth the city of Des Moines would only pay $75 per year for each arc lamp of 2,000 candle power used all night and every night for street illumination.

Admitting that $75 is a higher rate than the $65 which the engineering firm offers so supply the gas for, let us endeavor to ascertain whether the mayor was justified by the official records at his command in so arbitrarily fixing on $75 as a rate which the local lighting company must accept.

The proposed cost of arc lighting in Des Moines, when the municipal plant is in operation, will be:

Contractor's charge per arc lamp	$65.00
Insurance on plant per arc lamp	1.00
Sinking fund or depreciation at 5 per cent for arc lamp	10.00
Total cost	$76.00

The last official report of the cost of street lighting in Detroit shows that the annual cost to the city of Detroit for each arc light of 2,000 candle power, burning all night and every night, was $89.42, while operating 1,600 arc lights out of a possible 2,000, the remaining 400 being held in reserve. This cost of $89.42 was the total of five items: labor, $43.57; material, $20.62; depreciation, $1.85; interest, $18.28; taxes, $5.10. Depreciation is largely accounted for by maintaining the entire equipment in the best possible condition. But where complete replacement must ultimately follow, a depreciation charge of only 4 per cent. on first cost is entered. The total investment in Detroit is $714,843.76; a 4 per cent. charge on this equals $28,593.75; the assessed valuation is $427,500, calling for a charge of $7,981.43 for taxes.

The municipal plant in Allegheny City has been in service for several years and operates 1,100 arc lights of 2,000 candle power, and nearly 9,000 16-candle-power incandescent lamps. The cost per arc lamp per year is $74.32, divided as follows: Operating expenses, $53.55; interest charges at 4 per cent., $10.73; depreciation charges at 3 per cent., $8.04; taxes lost by city, $2. The cost of the arc plant was $259,258.43; of the arc and incandescent plants, $348,921, the city supplying the land. Included in the operating expenses per lamp, per year, were: Lamp trimming, $8; inspectors, $2; insurance, $1; coal at $1 per ton, $10; supplies, $4.20; repairs to arc equipment, $5.50; office and miscellaneous, 30 cents; repairs outside, $5; labor at station, $7.50; salaries at office, $3.25; carbons, $5; total, $51.75.

Mr. Hunter, the gentleman in charge of the Allegheny plant, has publicly stated that, in his opinion, fair price for commercial companies having overhead construction to charge for street lighting where arc lamps of 2,000 candle power were in service for 4,000 hours, is $80 per year, where good coal costs $1 per ton; if coal cost $2 per ton, $90; and $100 if coal cost $3 per ton. If the circuits in the downtown districts are underground, an increased ratio should be allowed to cover the interest on the increased investment necessary.

The facts regarding the Topeka municipal plant were officially reported in 1896 as follows: "The plant consists of a lot and building by a railroad switch; three boilers and three engines (worked by horse-power); six 30-light Jenney Indianapolis arc dynamos; six circuits with 24 72-100 miles of line, and 33 5-10 miles of wire, supported on 943 30-foot poles; and 184 lamps of 2,000 candle power each, placed 1,100 feet apart one way and 800 feet the other; a test of seventeen lamps showed an average pressure of 23 15-100 volts, and a current of 19 amperes equals 439 85-100 watts, or 1,953 nominal candle power. The lot and building cost $8,559.33; the plant, poles and wire, $46,888.65; total cost, $55,447.98."

In May, 1896, after less than seven years service, the old machinery in the Topeka plant was condemned as wasteful, unsuitable and unserviceable, and was finally exchanged for modern apparatus at an additional cost of $13,772. And in making this exchange only $1,500 in trade was allowed for the old apparatus, which means a depreciation exceeding 10 per cent. per year.

The officially reported total "cost of operating the Topeka electric light plant," from November, 1889, to December, 1892, inclusive, was $54,240.95, or an average cost per arc lamp per month for thirty-eight months of $7.75. The operating expenses are thus itemized, it being stated that "the best lump coal has been used, at an average cost of $2.75 per ton." Coal, $13,924.64; carbons, $2,981.31; globes, $235.80; oil and waste, $642.70; repairs, $4,847.57; insurance, telephone, etc., $1,329.96; pay roll, $19,743.85; interest, at six per cent., $10,535.12; total, $54,240.95.

In other words, Topeka paid during the first six years of municipal ownership, when machinery, circuits and lamps were new and in good condition, and cost of maintenance low, $93 per year for each arc light used in street lighting, not taking into consideration the extra investment necessary to replace old machinery, or the risk that attends all enterprises of like character, plus the loss of water rates, taxes, etc., which a private corporation would have paid. Moreover, there is $70,000 of the taxpayers' money locked up forever.

To recapitulate: The cost per lamp per year in the three most promising plants cited is shown to be officially reported as follows:

Detroit, Michigan	$89.42
Topeka, Kansas	93.00
Allegheny City, Pennsylvania	74.32

Or an average cost of $85 per year per arc lamp.

These are figures that every honest and practical engineer would accept as showing the best that has been accomplished under the most favorable local conditions. For the economical

[1] Read before the Northwestern Electrical Association. Abstract.

administration of the municipal plant in Allegheny has always been worthy of commendation, even by engineers who could not approve of the low allowance for depreciation. And the commission of six citizens under whose wise administration the Detroit municipal plant was placed in operation, and who gave two years' service free of compensation in any form, was guided in all its deliberations by a chairman whose wide experience and practical ability in successfully solving vexed problems arising in large financial undertakings has been amply demonstrated in many ways. And this commission secured the services of a practical electrical engineer of established integrity who had designed, built and operated many electric plants under conditions differing in each case.

In view of these facts from official reports, and of Mr. Hunter's statement that where good steaming coal costs $1 per ton, $80 is a fair price for commercial companies to charge for street lights of 2,000 candle power burning all night and every night, are not thoughtful investors in corporations properties justified in wondering whether this arbitrary action of the mayor in allowing only $75 per arc light supplied by commercial companies was simply a political stroke to gain the applause of unthinking voters? And are capitalists not justified in hesitating to invest a dollar in Des Moines? No state in the Union has a more intelligent population; few states so rich and productive as Iowa. Must all development be arrested for a term of years because a few men would sow the tares of municipal socialism in the hope that through awakening a hatred of all corporations they may reap certain political honors?

ELECTRIC LIGHTING

Electric Lighting For Profit.[1]—II.

BY ALEX. DOW.

A GENERAL DISTRIBUTION SYSTEM.—It is a serious handicap to a station when it is obliged to run two or three separate types of dynamos and to maintain two or three separate distributing systems for the supply of different shapes of energy. The best practice to-day is to furnish incandescent lights, arc lights, and electric motive power from the same dynamos and same mains. This is a subject to be considered in the original plan of the station, but there are instances where old stations have been rearranged with decided financial advantage. When a power load can be had even at the low rates already spoken of, a study of the local conditions should be made with a view to seeing whether a general distribution system will not be a source of profit. To design a new station with anything but such a system is almost criminal.

Supply of Street Railway Current.—There has not yet been devised a satisfactory system whereby a supply of 500-volt current for railway work can be combined with a general lighting distribution. Therefore a proposal that a lighting station should furnish such current must be dealt with as involving a new investment. This investment is always the cost of dynamo and switchboard and usually the cost of an engine. The street railway evening load in winter time coincides with the heaviest load on the lighting system for about two hundred hours per annum. At all other hours the street railway demand is a desirable addition to the load on the boilers, and in most stations the dynamo and switchboard can be cared for without cost for additional help. If the boilers are properly designed to suit the conditions, they may be driven beyond their usual rate during these two hundred hours with greater profit than would be possible if additional boiler capacity had to be installed. Furnishing street railway current appears therefore to be equivalent to the sale of steam to a special engine, and the furnishing of attendants to an additional engine and dynamo, and it should be considered as a business proposition on that basis and not in the same manner as a demand for current from the electric lighting plant.

Street Lighting Contracts.—If street lights can be served from a general distribution system, the rate should be made in the same manner as the rate for any other service from that system. As street lights usually run about four thousand hours a year, a rate made on a scientific basis will be very low in comparison with the rate for ordinary commercial lighting. This is not in accordance with the old practice of making all the profit of the business on a street lighting contract; but it is distinctly in accordance with the more modern practice which will probably become general.

Municipal contracts which can be performed without investment in special machinery are desirable business in that the payment is prompt and absolutely secure, and that the conditions of their performance are clearly laid down in the original agreement. For that reason the tendency appears to be to take such contracts at a very narrow margin of profit.

But when the performance of a street lighting contract requires an investment in special machinery and the building of special lines, such a contract is usually undesirable business. It is impossible under present conditions to secure such prices for street lighting as will return the investment to the stockholders within the term of the contract. The contracts are usually short and there is no security of their renewal. If in dealing with a municipality one were dealing with a business corporation having an established policy, it would be justifiable to take such chances, but our American cities, if they have a policy at all, change it from election to election, and no contractor can tell that the service which was deemed perfect by the Board with whom he made his contract, will not be entirely unsatisfactory to their successors with whom he must make a new contract two or three years hence.

In this respect we have another lot of educational work cut out for us. If we could make it clear to the mass of our citizens that the price for a year's street lighting depended on whether the street lighting plant would be employed next year or would be standing idle, we might have some chance to make close bids, without feeling that we were engaged in a risky speculation. The peculiarly exasperating part of the whole subject is that those same theorists who object to asking for bids on a contract running more than two or three years, are usually ready to lock up the good money of the citizens in a city plant which has to be security for thirty year bonds.

Special Sources of Revenue.—In many localities there are opportunities whereby the power of a lighting plant may be employed in work which is not usually considered as part of the lighting business. An arrangement with a manufacturer whereby machinery required by the plant during evening hours will be used by the manufacturer in the daytime, is often possible. A similar arrangement is made in many places for the joint use of a water power. The sale of exhaust steam for heating purposes is another source of revenue which is frequently neglected.

How Can Business Be Held When Once Obtained.—In these days of competition this subject becomes of the greatest importance. We have against us in every station some competition. In the larger cities we have to meet the offers of opposition companies doing a similar business to ourselves; the arguments of the man who wants to sell isolated electric plants to our best customers, and the ever present cheap service offered by the gas company. In the smaller towns and villages the worst obstacle to the holding of business is the tendency of our customers to economize by cutting down the amount of light used. This tendency is present also in the large cities but is not so constantly in evidence because many city people must use light liberally in order to carry on their business. The whole law and gospel of holding business consists in getting your customers to believe that they receive good value for their money. It is not sufficient that you should believe it; you must convince the customers. But it tends to make your success more certain if you know in your own mind that you really are giving good value. For this reason it is essential that you know what each block of lighting costs; which brings up again the subject of analysis of expenses.

No matter how cheaply you offer to sell your products, it is essential that the customer is satisfied with what is delivered to him. Therefore, if he wants to use arc lights you must see that they are quiet and steady. If he buys current from you wherewith to operate a motor, you must make it your business to see that his motor runs satisfactorily. It is not a part of your contract to do this, but if the motor does not run as it should you will go up there some day and find that he has bought a gas engine. If you sell him current for incandescent

[1]Read before Northwestern Electrical Association, Jan. 19, 1898, at Milwaukee. Abstract.

lighting, you must see that the lamps are renewed before they become dim. If you cannot get the customer to buy new lamps, you had better arrange to furnish renewals free, as most stations now do. If even then your customer is slow about calling for renewals, you had better send one of your men up to change the lamps. Neglect in this respect probably means that there will be a sale of Welsbach burners in the neighborhood of that customer. You must be prepared to send assistance to him when he mixes things so that fuses get blown, and you must send this assistance promptly. This may mean that a man has to idle around the station waiting for trouble calls, but you should not think that man's idleness gives you a chance to economize by discharging him. You should look upon it as the outward and visible sign that your customers are getting good service. And above all, you must take such precautions that your service may be relied upon by all who employ it. There is nothing that does so much to damage the business of a station as a reputation for unreliability.

Conclusion.—In closing I wish to say that I am preaching no doctrine which I do not believe, or which I do not try to follow. Neither do I imagine that the stations represented in this association are less carefully planned, or less efficiently managed than those of the rest of creation, that I should address myself to you rather than to others. But it is by electric light men and no others that the advice must be given to those who need it. And each of us has the opportunity at some time to counsel with the man in the next town of whom we have been speaking. While I was in the act of preparing this paper I was asked for advice in just such a case and gave verbally just the same advice that I was putting in writing for presentation to you.

This is a final summary of the opinions I have presented:

(1) The electric lighting business should pay as a reasonable profit, approximately the same rate as any manufacturing business which has similar risks. This profit should be paid after the expenses of operation, maintenance and depreciation shown by annual inventory have been provided for.

(2) Rates for electric supply should be so adjusted that each unit sold will pay its share of operating and standing charges, and in addition thereto a uniform proportion towards profit. No business should be done at a loss and no business should pay more towards profit than its proper share.

(3) Every class of business that can be profitably done should be obtained. Business that improves the load factor should be taken if it can be obtained at any price greater than its share of operating and standing charges, because the improvement of the load factor reduces the amount of standing charges to be borne by existing load.

(4) Business once obtained should be kept by careful study of and prompt attention to the requirements of each customer. It is not possible in the present stage of electric development for an American electricity supply company to limit its interest in the supply to its delivery on the customer's premises. It must do much work in order to secure that the customer uses the supply to the best advantage. It is not sufficient that a customer should be well served, he must also be well pleased.

(5) There is need of educational work to be done among electric light men, among municipal authorities and municipal theorists, and among our own customers. It is our interest that this educational work should be done and as it does not appear to be the duty of any other person to do the work, we will have to do it ourselves.

How to Prevent Arc Lamps from Freezing.

BY WILLIAM FOWDEN,

Superintendent Camden, N. J., L. & H. Co.

I HAVE heard a number of complaints from central station men that they have a great deal of trouble from lamps freezing up in sleet storms. We experienced the same trouble until we hit upon the following plan. We take a number of thin sheets of cardboard and punch a hole in them the same size as the carbon and if the trimmer thinks that things are going to freeze he slips one of these small pieces of cardboard on the upper carbon of the early side of the lamp. This will act as a shed for the water, and we find very few cases where the lamp will freeze up where this has been used. I feel sure that our experience will help more than one central station man out of this trouble.

English Incandescent Lighting and Railway Statistics.

THE yearly supplement table of electrical central stations of the United Kingdom, published by the London "Electrician," contains some remarkable statistics which form the basis for the following comparison between the present output of the various stations and that of previous years: Fig. 1, which shows the rate of increase of the lamp connections of the London companies and municipalities since 1890, gives evidence of a very flourishing condition of affairs. Although the Metropolitan still leads in the number of lamp-connections, it was not to be expected that the enormous increase of last year would be repeated, but still an addition of 45,000 8-c. p. lamps in the year shows that the saturation limit is still very far distant. The greatest increase—50,000—can be claimed by the City of London Company, its curve having already passed that of the Westminster Company, although the lamp-connection of the latter has also shown a healthy improvement. The St. Pancras curve is "looking up" again this year, and the only one

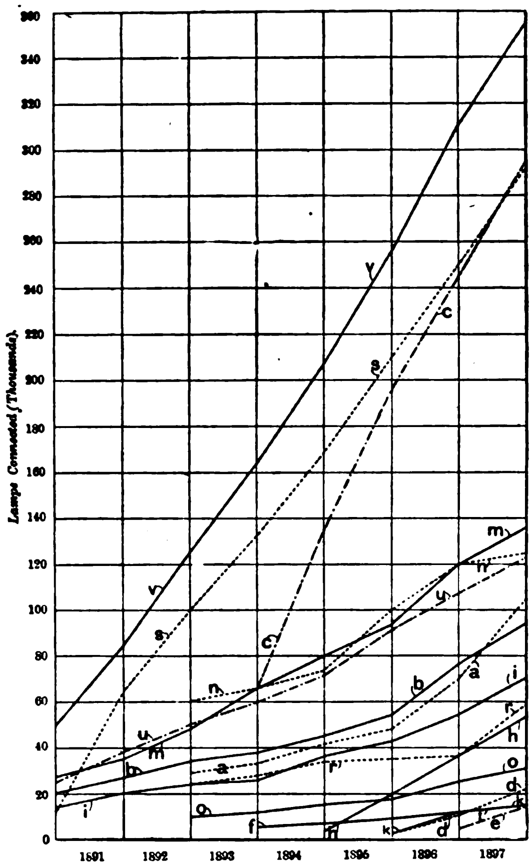


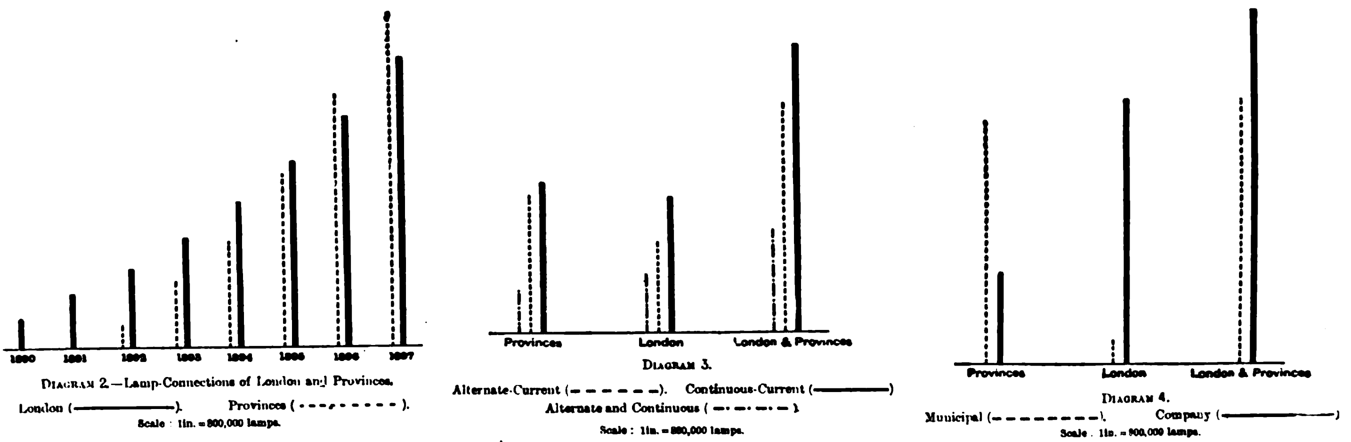
FIG. 1.—LAMP CONNECTIONS IN LONDON.

a, Charing Cross Company; b, Chelsea Company; c, City of London Company; d, County of London and Brush Provincial Co. (Clerkenwell); e, County of London and Brush Provincial Co. (Wandsworth); f, Crystal Palace Company; h, Hampstead Vestry; i, House-to-House Company; k, Islington Vestry; m, Kensington and Knightsbridge Company; n, London Electric Supply Corpn; o, Notting Hill Company; r, St. Pancras Vestry; s, Westminster Corpn; u, St. James and Pall Mall Company; v, Metropolitan Company.

which shows possibly transient signs of approaching saturation is that of the London Electric Supply Corporation.

Fig. 2 shows that the provinces are increasing their lamp-connection still faster than London. During 1897 the London total became 1,831,000, an increase of 369,000 since the end of 1896, the increase in the previous year having been 283,000. The total for the provinces is 2,129,000 at the end of 1897, showing an increase of 527,000 during the year, as compared with 502,000 during the previous year. The total for the whole of the United Kingdom is therefore very nearly four millions of 8-c.-p. lamps or their equivalent, this number being undoubtedly considerably exceeded if private stations be taken account of.

Owing to the number of stations which supply both continuous and alternating currents, the "Electrician" has been obliged to make a change in Fig. 3 this year. The aggregate lamp-connections of the stations supplying only continuous current is, it is seen, considerably greater than that of the stations which supply nothing but alternating current; yet it is probable that



FIGS. 2, 3 AND 4.

more alternating current is being supplied than continuous, as the majority of the "mixed" stations have only recently adopted continuous current for special purposes. The height of the chain-dotted line for London is, for instance, almost entirely due to the Metropolitan Electric Supply Company, the continuous current connection of which is, however, but a small proportion of its total load.

Fig. 4 indicates further additions to the municipal load, especially in the provinces, new municipal stations having been opened at Harrogate, Torquay, Wakefield, and Wallasey during the year, and in London at Hammersmith.

Tables I., II. and III. give the figures which are shown graphically in the figures 3 and 4.

TABLE I.—DETAILS OF LAMP-CONNECTIONS IN LONDON AND PROVINCES.

LONDON (1,83c,995)	MUNICIPAL (149,410)	—	72,693
		∽	76,717
		$\underline{\sim}$	none
	COMPANIES (1,681,585)	—	798,588
		∽	505,050
		$\underline{\sim}$	377,947
PROVINCES (2,128.655)	MUNICIPAL (1,546,282)	—	733,554
		∽	538,205
		$\underline{\sim}$	274,523
	COMPANIES (582,373)	—	229,104
		∽	343 669
		$\underline{\sim}$	9,600

TABLE II.—APPROXIMATE LAMP-CONNECTIONS OF ALTERNATING AND CONTINUOUS-CURRENT STATIONS.

—	$\underline{\sim}$	∽	—	TOTALS
London.............	378.000	582,000	871,000	1,831,000
Provinces......... ..	284,000	882,000	962,000	2,128,000
Totals.........	662,000	1,464,000	1,834.000	3,959,000

TABLE III.—APPROXIMATE MUNICIPAL AND COMPANY LAMP-CONNECTIONS.

—	MUNICIPAL.	COMPANY.	TOTALS.
London.................	149,000	1,682.000	1,831,000
Provinces..........	1,546,000	582,000	2,128,000
Totals	1,695,000	2,264,000	3,959,000

The "Electrician," from which the above diagrams are taken, has also issued a map of the central stations of the United Kingdom, showing their location, whether they employ the continuous or alternating current and indicating the stations owned by private companies and municipalities. This map shows that the space distribution of the stations has departed from uniformity in a marked degree.

The Table of Electric Railways and Tramways shows that there are 23 lines in operation in the United Kingdom, that the construction of 25 others is sufficiently far advanced to make it probable they will commence running before the year is ended, and that there are now projected schemes for the construction of 10 underground electric railways in London, and 48 light railways and tramways in London and the provinces. The lines in actual operation, together with such as will commence running in a very few weeks comprise over 150 miles of track, while the aggregate track mileage of the lines working and in course of construction approximates 400 miles.

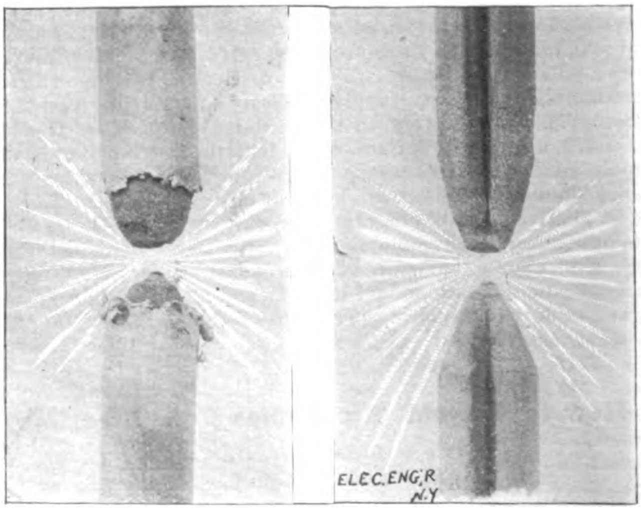
By far the greater number of the concerns embodied in the table, whether as being in operation, in process of construction, or merely projected, relate to the overhead trolley system. In the great field of the electrical equipment of town roads neither the battery car nor the conduit system has advanced, and no instance exists of a public railway being worked on a surface contact system as regards the United Kingdom, while the third-rail conductor system has been reserved exclusively for underground and overhead railways.

The "Open Arc" Grooved Carbon.

THE "open arc" carbon is the name which has been given to a new and interesting form of arc carbon recently brought out, and for which a number of valuable qualities are claimed, not met with in the ordinary form of solid carbons.

The distinguishing feature of this new type of carbon is a longitudinal groove running from one end to the other parallel with the length of the carbon, as shown in the accompanying figures.

By the use of this carbon it is claimed, first, that the vortex action of the current is checked by the groove, and the crater



FIGS. 1 AND 2.

of the carbon is held stationary at the apex of the pencil; and what is still more important, is that the size of the white light crater is nearly double that of any other carbon. This is explained by the inventor thus: With the solid or cored carbon that part of the white light crater is only visible which is on the apex of the carbon; with the grooved carbon, however, the crater appears as well on the sides of the segment cut-out of the carbon as on the end, almost doubling its light rays.

It is also claimed that with a solid or cored carbon, the maximum heat point is the center of the carbon, hence, the

center of both carbons disintegrates too rapidly, leaving walls on either side which, a large portion of the time, obscure the crater, and build up on the lower carbon to a point that shuts off the rays from traveling downward. With the "open arc" carbon, it is claimed that the grooves cut the material from the center, leaving nothing there, and throwing the maximum heat point to the sides of the pencil, thus giving the lower stick a cone-like form, and allowing all the rays to travel downward.

The accompanying engraving illustrates this action, and was made from photographs taken from two sets of carbons burning side by side in high tension lamps, both sets of carbon being coppered. Another point made, is that a ⅝-inch carbon, solid or cored, while desirable for a long run, is a poor light developer; but with the "open arc" carbon, this result for the reasons before given, does not obtain.

This new form of carbon is said to increase the illuminating power of the arc from 30 to 40 per cent., without any increase in current consumption, and if this be so it unquestionably has claims to recognition. We may add that the new product is being introduced by the Open Arc Carbon Co., of 108 Fulton street, New York, and that a number of prominent electrical men are interested in the company, among them Mr. Charles A. Lieb and Mr. Caleb H. Jackson.

ROENTGEN RAYS

An X-Ray Picture of a Loaded Lebel Rifle.

PROFESSOR RŒNTGEN has shown that the X-rays are disseminated in the bodies which they traverse similarly to light passing through distorted media. Recently the importance of this discovery has been more fully recognized in regard to the disturbances which are produced in certain radiographic operations.[1]

When a very opaque object, like a large watch, is interposed between a powerful Crookes tube and a photographic plate, the X-rays are powerfully disseminated in the space which they traverse behind the plate, making impressions on the back, that is the side of the glass which carries the sensitive film. This impression, or shadow, increases uniformly with the duration of exposure. The result is that a relatively short exposure gives a faint silhouette of the mechanism of the watch, but the impression seems a trifle blurred. The value of the impression at first increases with the time of exposure, but this reaches a certain limit when the impression rapidly grows bigger under this double radiation and becomes more and more gray until all the details of the silhouette are lost.

It is evident that one can prevent the shadow of the return rays when, in getting ready for the experiment, a sufficiently opaque screen is placed against the back of the sensitive film. A sheet of lead half a millimeter in thickness is ordinarily sufficient. This thickness can be increased in exceptional cases.

This precaution is not necessary when a little less powerful tube is employed, because the glass on the back of the plate is then sufficient to arrest all the return rays. For the radiographs of very opaque objects requiring very long exposures, placed in front of powerful tubes, it has been found expedient to use a sensitive preparation of loose films of double commercial gelatine and lay them on lead sheets of the same shape, enclosing the whole in black paper whose object it is to arrest the ordinary rays of light.

[1]Buguet French Academy of Sciences, November 2, 1896; August 16 and 25, and November 8, 1897.—Roentgen, L'Eclairage Electrique, July 17, 1897.

The role played by the back screen is clearly brought out in a radiograph of a large watch obtained after an exposure of two minutes at a distance of 12 centimeters from a very powerful tube, only half of the back being protected against the return rays by a metallic screen. The protected part gave a very detailed silhouette of the interior mechanism, whilst a thick shadow conceals nearly the entire other half.

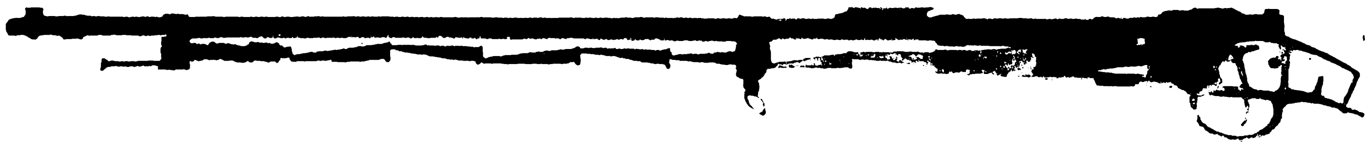
This may explain the numerous failures which have been met with in even the best radiograph work designed for the study of very opaque substances in the human body and of metallic objects generally.

By using a back screen, there are obtained, for example, all the details of construction of cartridges. The hunting cartridges, for example, allow the experimenter not alone to see the arrangement of the charge, of the wadding and the nature of the powder, but also the irregularity of the metallic socket, the form of the capsule and the position of the trigger.

A copper pistol and a revolver which will not produce a shadow by the old methods, exhibited the balls clearly in place when the back screen was employed as described. This has helped the experimenter to obtain also several radiographs of a Lebel gun by relatively short exposures, these having been, at 20 centimeters, 10 minutes for the locking parts, and 1 minute for the other parts. Referring to the figure, one can clearly see through the two steel jaws, the swinging tray, and the cartridge which it contains ready to pass into the barrel. Eight cartridges can be distinguished at different angles and all pressing in line against the coiled spring which pushes them forward.

One can finally distinguish that these cartridges are of the kind used by shooting clubs, as the powder is granulated and not "ribboned" like that which M. Vieille uses for cartridges for warlike operations.

The above data is part of an article contributed to "La Nature" by Abel Buguet, Professor at the School of Sciences and the School of Medicine of Rouen.



RADIOGRAPH OF A LEBEL RIFLE.

The Effect of Röntgen Rays on Plants.

PROF. G. F. ATKINSON, of Cornell University, publishes in the January 7 number of "Science" a "Report upon some preliminary experiments with the Röntgen rays on plants," from which the following extracts are taken: Since it is a matter of some interest to know what influence, if any, the Röntgen rays would exercise on plants, I undertook a series of somewhat extensive preliminary experiments, to determine what lines of investigation might profitably be carried on should there be marked indications of any response to possible stimuli from this source.

The author then describes twelve experiments in which he used the following substances: Leaves, seedlings of corn, a begonia plant, a caladium plant, species of mucor, several forms of chromogenic bacteria, a motile bacillus, sensitive plants, etc., and draws the following conclusions: It is thus seen that plant tissues absorb the Röntgen rays quite freely, and it is singular that there is not a more marked influence on growing parts, especially that there are no visible external injuries, even when the parts are exposed at close range a large part of the time during several days, since the general impression is that the rays, even with comparatively short exposures, are injurious to the human tissues.

The longer his experiments continued the more mysterious the whole subject seemed. On a dark night, when the electric light rays were intercepted by a black screen, exploring the field with a fluoroscope there was an abundance of light, flashing and quivering with the variations in the electric transmission through the tube, penetrating, and yet capable of absorption to a considerable degree. That it should present no easily discernible influence for the time during which the work continued was cause for profound surprise.

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Possibilities and Limitations of Electric Traffic.

IN the current issue of the "Engineering Magazine," Mr. Frank J. Sprague concludes his exceedingly interesting essay on the possibilities and limitations of electric traction, already noted in these columns. In this portion Mr. Sprague, leaving the question of city and suburban traction, takes up the larger problem of the main line. As he shows, it is no longer a question as to whether a locomotive can be built of suitable power and reliability, and sufficient energy could be transmitted, nor a mere question of power economy with the possible advantages to be gained by utilizing a convenient water power. Other elements have entered into the discussion at the present time. Among these Mr. Sprague notes, first, the question of signaling, and on this point he believes that it is safe to assume that a practical system can be devised. As to the matter of brakes Mr. Sprague ventures to prophesy the not distant advent of an entirely successful electro-mechanical automatic brake. Mr. Sprague has been a pretty good prophet in the past, and in this case he probably goes very safely, admitting, as he does, that he is now working on plans for just such a brake, utilizing his experience on a similar apparatus in connection with his elevators. As to the conditions of current supply, we are glad to note that Mr. Sprague lays particular stress on the value of the storage battery, not so much as a storer of energy as a regulator. Still there are cases in which the storage battery enters directly into the problem as a reservoir of energy, as, for example, at Buffalo, where, according to Mr. Sprague, Niagara power, in order to compete with coal at $1 per ton, had to be supplemented by a storage battery charged during the entire twenty-four hours of the day. Mr. Sprague also tells us that some months ago he made definite proposals to put on the Manhattan Elevated Roads in New York two or more storage battery stations, supplied by rotary converters operated from a multiphase transmission plant, or by steam engines and dynamos of moderate capacity locally installed. Given as available all the apparatus necessary to operate a main line electric road, Mr. Sprague then inquires how far a trunk line is warranted in the adoption of electricity. Broadly stated the answer depends entirely upon the conditions of the traffic. As to the much-talked-of long distance, high speed electric railways, such as from New York to Chicago, devoted exclusively to passenger service with all the existing possibilities of passenger traffic, Mr. Sprague believes that such a line could not return interest on the investment, no matter what the rate of speed determined upon, nor how attractive it could be made. This must be a sad blow for many enthusiasts, who dreamed of breakfasting in New York and lunching in Chicago, and the statement coming from such an optimist as Mr. Sprague himself should put a quietus on many of the roseate descriptions of the traveling facilities of the future. Mr. Sprague also sounds a note of warning when he points out that in calculations looking to the adoption of electricity on main trunk lines the fact must not be lost sight of that there is an increase of investment as an offset to any saving in transportation account and cost of power. In other words, that while fewer electric locomotives could safely do the work of a given number of steam locomotives, still, considering all classes of equipment, it is safe to assume that the cost of the power equipment supplied to the rolling stock will be fully as much for any electric system as for steam. It is, therefore, only when the saving in fuel, transportation, wages, lower depreciation, and gain of business will insure a material dividend on the increase of investment that such a step would be advisable. This no doubt may appear to be cheering news to many steam roads which still dread the change to electricity, but it would be well for them not to lull themselves into the belief that the conditions as here outlined are but infrequently met with. No doubt on sections of light traffic such conditions would apply, but there are others, not few in number, in which the reverse might prove to be the case. Again, as Mr. Sprague points out, increase of traffic requirements, especially under the spur of competition, are continually making improvements necessary, while the abolition of grade crossings and the adoption of rock ballast and duplication of trackage all tend directly towards electric methods. Even where a complete system is not equipped electrically, Mr. Sprague points out that electric motors may be used profitably to assist steam trains over heavy grades. Apropos of the predictions as to the employment of electric feeders for steam main lines, Mr. Sprague makes the somewhat heretical observation that he expects to see in some instances the reversal of this idea. That is to say, under certain conditions the outlying and infrequently served portions of a system may be steam, while the main section with the concentrated traffic may be electric. The argument is, however, quite logical. Of course, Mr. Sprague lays particular stress on the value of the multiple unit system of control which he has developed, and which is now in such successful operation in Chicago. Taken altogether Mr. Sprague's essay is an excellent statement of the problem, and to his conclusions little exception will be taken by those competent to pass an opinion thereon. We recommend its study, particularly to our steam railway friends.

Electric Lighting and Traction in England.

ON another page we present some central station statistics, compiled by the London "Electrician," from which very interesting conclusions may be drawn. The diagram indicating the current supplied by the various London companies for lighting purposes shows an improved state of affairs. Especially in the provinces, the use of the electric current for lighting is finding more and more favor, the total being 2,129,000 lamps in 8 candle power lamp equivalents, an increase of 527,000 during the year 1897. The total for the whole of the United Kingdom is very nearly four millions of 8 candle power lamps or their equivalent, that is excluding isolated plants. It appears from the diagrams that the alternating current predominates over the continuous current, and the number of mixed stations is surprisingly on the increase. The map accompanying the tables shows, as may be expected, a very uneven space distribution of the central stations, the greatest density being around London, Liverpool and Manchester. There are only eight central stations in both Ireland and Scotland, and one in the course of construction in each. There are about an equal number of municipal and private company plants, but of the twenty-seven central stations in the city of London, only six are owned by the municipality.

Turning now to the statistics of electric railways in Great Britain and comparing them with similar data published last year, we find that during 1897 electric traction in the United Kingdom has made rapid strides. However, to the electrical engineer on this side of the Atlantic it is cause for astonishment to learn that there are only twenty-three lines in operation in Great Britain, and twenty-five in the course of construction; besides ten underground electric railways projected for the city of London as well as forty-eight light railways for London and the provinces. Of the twenty-three lines in operation, eight employ the center overhead trolley, six the side trolley, five the middle rail, and one each of the following: Third rail, battery, side rail and slotted conduit.

The lines in actual operation, together with such as will begin running in a very few weeks, comprise about 150 miles of track against 15,000 miles in the United States. While this comparison is certainly striking, and we venture to say, ludicrous, it is a source of gratification to be able to record the fact that our English brethren are constructing a larger number of electric railways this year, than the total number in operation in Great Britain at the present time. "There is life in the old dog yet."

The New York Edison Co.'s Annual Report.

THE Edison Electric Illuminating Company of New York, being the largest electricity supply company in the world, and the city within which it operates being the metropolis of the United States, as well as the center of financial and commercial interests, it always appears proper to use the company's report of a year's operation as a safe criterion for the electric lighting industry and general prosperity of this country. If this be so, it is encouraging to note that the record of 1897 stands supreme in the history of electric lighting and the use of the electric current for power purposes, while the outlook for 1898 is most hopeful and encouraging.

On another page we give an extended abstract of the very exhaustive and able report of First Vice-President Bowker, which shows that the business of the company has had a steady increase with gratifying financial results. The progress of the company in the eight years of its existence shows six times the number of customers, seventeen times the installation, eight times the maximum output, on but fivefold the capital, with over seventeen times the gross and nine times the net income. The company has now 7,313 Edison customers, installations of 346,723 incandescent and 4,775 arc lamps, and 19,364 horse power in motors, being an equivalent of 696,370 16 candle power incandescent lamps, exclusive of 60,068 high tension and 80,928 "breakdown" connections, equivalent in all to 837,366 16 candle power lamps, which number will probably reach the 1,000,000 equivalent mark in 1900. Moreover, 100,000 amperes maximum output was reached in 1897; the company has $14,500,000 in round numbers, loan and share capital; its gross income for combined systems was, in 1897, $2,486,636, and its net without depreciation charges $1,261,497 or 50.7 per cent., or, deducting depreciation charges, $1,117,497, or 45 per cent.

For the Edison system only, the gross station returns have increased 13.7 per cent., and the general and operating expenses have increased 10.9 per cent. Nearly 1,000 service connections were added during 1897, and we note the change from chemical to mechanical meters so as to eliminate as largely as possible all errors due to incorrect measurements of current which have now been reduced to 1/5 of 1 per cent. The low tension arc light service has been greatly extended, the number of arc lights having been increased from 3,225 to 4,775; and in this direction remarkable developments are expected in the near future. No fewer than 236 inclosed arc lamps were installed, a contract for 300 more for city lighting has just been closed, and a number of city buildings and armories have lately been furnished with lights. We again wish to record the satisfactory relations which exist between the company and its employés. It is a certain guarantee of efficient work on the part of the latter.

However, the most significant, and to the consumer the most important item in the report is the chapter on rate reduction, which was supplemented on February 1, by circulars issued by the Edison Company and the companies which it controls. It was only last October that a circular was issued announcing a reduction of rates for long-hour use of the electric current, and containing the statement, that if the arrangement proved satisfactory, a discount would also be extended to the small consumer. This has now come to pass, and in the new circulars of the allied Edison, Harlem and Manhattan companies, who believe that the reductions in the prices of current will broaden their fields of operation and thus make still further reductions possible, remarkably low rates and large discounts, on experimental bases, are quoted to the consumer, large and small.

The new discounts of the Edison Company, whose base price for incandescent lighting is 1 cent per 16 candle power lamp hour, including renewal of lamps, range from 5 per cent. for $100 to 40 per cent. for $1,000 or over gross monthly bills. An additional discount of from 5 per cent. for 50 hours to 25 per cent. for 150 hours monthly average use of each 16 candle power lamp (equiv.) installed, is quoted. The base price for arc lighting is 10 cents per 8-ampere lamp hour, with discounts of from 10 per cent. for 100 lamp hours to 35 per cent. for 1,000 arc lamp hours, and an additional discount for long-hour use of from 5 per cent. for an average burning of 100 hours to 15 per cent. for 200 hours average monthly burning for each lamp installed. A special discount of 10 per cent. is allowed to consumers owning their arc lamps. Power service is supplied at a base price of 10 cents per horse-power hour with discounts ranging from 20 per cent. for 100 horse-power hours to 50 per cent. for 1,500 horse-power hours, 55 per cent. for 5,000 horse-power hours and 60 per cent. for 10,000 horse-power hours. A wholesale price on the kilowatt basis is made to consumers using not less than 2,500 kilowatt hours per month. Heating is supplied at power rates and storage batteries also when used outside of maximum hours, and in large quantities at 6 cents per kilowatt hour with special discounts to large consumers.

In order to make a fair test of the expediency of varying rate methods in the various sections of the city, the Manhattan Electric Light Company and the Harlem Lighting Company, both controlled and operated by the Edison Company, have issued circulars similar to the above in which they quote very liberal discounts to their consumers, subject to change after a period of three months. The new rates of the Manhattan Company are as follows: For the first two hours' daily consumption 1c. per lamp hour, for the second two hours' 1/2c. per lamp hour and for all over four two hours' consumption 1/4c. per lamp hour. The discounts of the Harlem Company on a base rate of 1c. per lamp hour are: For 50 hours' average monthly burning per lamp 5 per cent., and for 60, 75, 85, 100, 125, 150, 175 and 200 or over, discounts of 10, 20, 25, 30, 35, 40, 45 and 50 per cent., respectively.

Electricity can be furnished, when used through a number of hours each day, for a lower cost than gas and the object in giving these different rates to the consumers is to find out which one of the proposed methods commends itself most to the public. We hail the new announcement of this progressive company with delight, and believe that the sharing of profits with the customer will have the effect of a more extended and varied use of the electric current than ever. It is but another evidence of the far-sightedness and public spirit of the Board of Directors and of the ability of the general manager, Mr. J. W. Lieb, Jr., who are all entitled to the gratitude of the electrical profession for thus placing the electric current within the reach of all who desire to use it for lighting, power, and other commercial and domestic purposes. It is liberality of management which must reap its own reward.

A Fifty Thousand Volt Transmission At Telluride.

IT is a fact not generally known that a transmission at 50,000 volts was some time ago tried for a period of two weeks from the water power plant at Telluride, Col., to the Gold King Stamping Mills there. The Telluride transmission is well known as one of the earliest in this country. The first plant consisted of a single phase 3,000 volt alternator with direct transmission to a synchronous motor three miles away. This has since been replaced by a three-phase transmission with step-up and step-down transformers.

It was about the time the change was made that the experiment was tried of transmitting at 50,000 volts three-phase alternating current. The transformers used were those now employed on the three-phase transmission there, said transformers being arranged to give a number of different voltages from 50,000 down according to the way they are connected.

As said before, this transmission at 50,000 volts three-phase current was kept in service for about two weeks and no accidents occurred during the time. The line consisted of galvanized iron telegraph wires supported on glass insulators. It was found that the self-induction afforded by the iron wire had a beneficial effect in counteracting the capacity of the line. The experiment was not continued for a longer time because a rainy season came on and proper provisions against lightning were not at hand. The transmission line is three miles long and runs up a steep mountain side and over a very wild country. It was illustrated some four or five years ago in our pages at the time of its first installation, in the early days of direct current power transmission. The many inquiries we receive as to transmissions above 10,000 volts will be answered to some extent by the information now given.

MISCELLANEOUS

The Voltex Process of Electric Welding, Soldering and Lead Burning.

It has long since been recognized that for very many purposes, electric welding offers numerous advantages over the ordinary method of welding in a smith's fire, and within the last ten years several systems have been devised, and have achieved more or less success. Many attempts have been made to make use of electricity for brazing purposes, owing to the numerous advantages which a simple electrical method would have over the ordinary gas and coke brazing hearths, but hitherto all these attempts have been failures as far as practical work is concerned.

The Voltex process, developed by The Electric Metal Working Syndicate, Ltd., 61 and 62 Gracechurch street, London, E. C., is said to have overcome these difficulties and made electric welding and brazing practicable in the smallest as well as in the largest works.

The apparatus consists, as will be seen from Figs. 1 and 2, of a carbon holder and a pair of carbon electrodes. In using the apparatus an arc is struck between the electrodes, and owing to the material of which these are made and their arrangement in the tool holder, a powerful flame like that of a gas blowpipe, but of much greater range of temperature, is projected from between the adjacent ends of the electrodes, and is directed upon the material to be heated.

The portion of this "blow-pipe flame" nearest to the carbon points is of the highest temperature obtainable by artificial means and its temperature gradually decreases as the distance from the electrodes is increased.

The workman, therefore, by merely varying the distance of his work from the electrodes can apply to it a blow-pipe flame of a temperature ranging at will from that of the arc itself down to a temperature comparable to that of an ordinary gas blowpipe. By varying the voltage, or electric pressure, by means of a regulating switch, the power of the blast can be still further

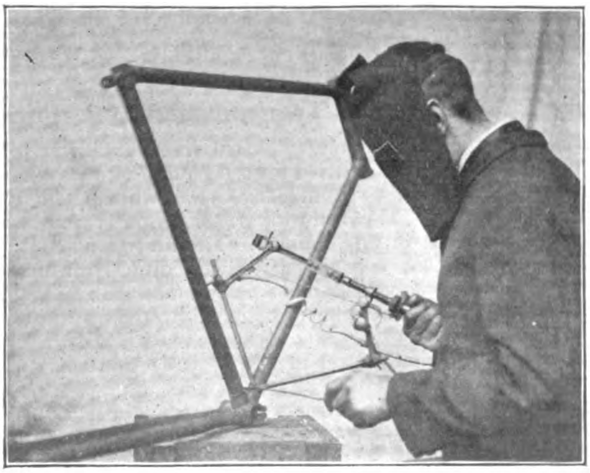


FIG. 1.—WORKMAN BRAZING CYCLE FRAME WITH BRASS WIRE SEEN IN HIS HAND.

increased or diminished at will. The process is thus an extremely simple one and the tools may be moved from place to place in the workshop, or factory, as may be convenient.

The advantages claimed for the process are:

1. It is so simple that any workman can use it efficiently after a very little practice, the tools being as easy to use as a soldering iron. 2. It is economical. 3. It requires practically no outlay for installation, provided a source of electric supply is available. 4. The apparatus is such that it can be taken to the work instead of the work having to be taken to the tool. 5. Work can be executed which is impossible by other methods. 6. Malleable iron and steel, as well as cast iron, can be treated by the process, and, if requisite, raised even to the fusion point without being rendered hard or brittle.

The process has been successfully employed for welding wrought iron and steel; joining cast metal sections, cycle brazing, general brazing, welding and brazing girders and other iron work in locomotive and railway shops, cable manufacture and trolley work, tempering tools, brazing of band saws, work in connection with ship building, brazing of copper steam pipes and boiler tubes of brass and copper. In iron ship building the rivets may be inserted cold and can therefore be used of the

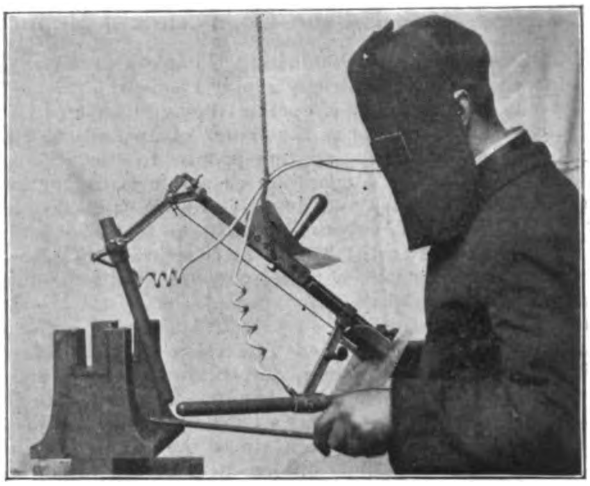


FIG. 2.—WORKMAN FILLING UP FLAWS IN IRON CASTING. (By means of carbon rod held in hand, small pieces of cast iron are pushed into the hole after metal in latter begins to run.)

full size of the holes drilled to receive them, the heads being brazed over, after heating by means of a voltex tool.

When an installation has to be put in expressly, the alternate current is preferable, as with the alternating current both carbons remain pointed, and, of course, burn evenly away; but the great advantage is that the voltage can be altered with great ease without any great waste by means of a choking coil. For brazing work forty-five to fifty volts are generally employed, and for heavy welding and filling up flaws in large iron and steel castings from fifty to fifty-five volts are used. We are indebted to Mr. G. W. de Tunzelmann, inventor of the system, for photographs and details.

The Lamina Accumulator.

The Lamina Accumulator, manufactured by the Elieson Lamina Accumulator Co., Ltd., London, belongs to the Planté type of accumulators. It is generally supposed that for storage capacity, per unit weight of plate, accumulators on Planté's principle cannot compare favorably with pasted cells. The "Lamina" plate has demonstrated to the contrary. The following is a brief description of the construction of the cell: Lead is received in the form of rolls 8 to 10 inches wide and of thicknesses varying from 1-64 to 1-32 inch. This lead is first perforated, in a machine specially designed to give the amount of perforation per square inch which experiment has proved to be the most satisfactory. The lead then passes to the corrugating machine. After corrugation it is cut up into sheets of the required size. These sheets are surrounded by a large sheet of the same material which entirely envelops the sheets. The capacity of the plate depends upon the number of sheets or laminæ used. The corrugations are placed alternately, vertically and horizontally or at an angle if desired. The plate has now to have a number of holes punched in it. The number of course varies according to the dimensions of the plate. Into these holes rivets are placed, and afterwards these are fixed by means of burning; the plate is also "stitched" along the joint of the outside sheet, and tops and bottoms are "burnt" on. The plate is now ready for formation. This takes about 36 hours and the effectiveness of the process may be judged from the fact that during the first 24 hours no gases are evolved which shows that the whole of the current is utilized in converting the surface lead into active material. After formation the plates are reduced and if the plate is intended for a negative it is then complete; if it is intended for a positive, it must be oxidized. Both these processes take from 36 to 40 hours. The plate is now

finished and cells may be built up according to requirements. During formation the outside sheet is protected, thus it is not attacked to anything like the extent that the inside or unprotected sheets are. The advantages of this are of course that it retains its mechanical strength, and also conductivity. The mechanical strength of the plate is very good, buckling being practically impossible, the corrugations adding greatly to the strength. Extremely high rates of charge and discharge are possible with the "Lamina" plate. The cells may be charged and discharged with perfect safety in an hour. The cells stand well

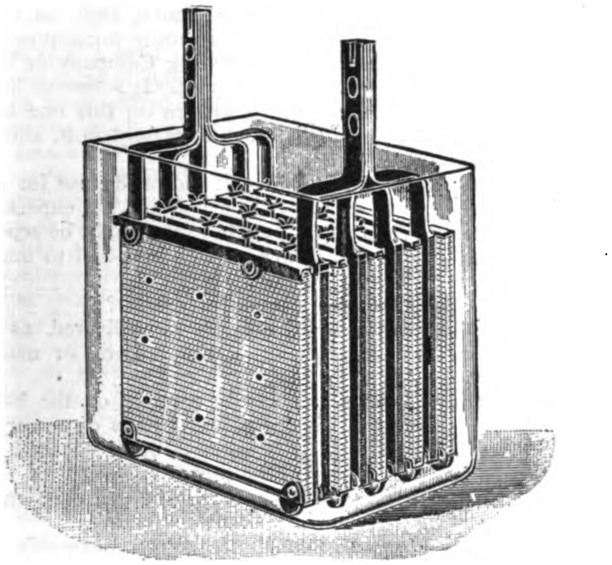


FIG. 1.—LAMINA ACCUMULATOR; LIGHTING TYPE.

the severe work imposed upon them when used for traction purposes. It will be obvious from the method of construction, that enormous surface is obtained, and free circulation of acid to every part of the plate. Plates of any size or shape can be built just as easily, as the company's standard sizes. Thus a good many "Lamina" positives have been supplied for renewing pasted positives.

The following is an abstract from a report rendered by Prof. S. P. Thompson, F. R. S., D. Sc.: "This accumulator is specially designed for traction work, and has a very high output for its weight, as well as great durability. Under normal conditions its capacity for storage of work is about 14 watt hours per pound weight (gross) of the cell. This figure is as high as that of any accumulator yet in the market, and higher than that of any accumulator of equal durability. Or, to put it in another

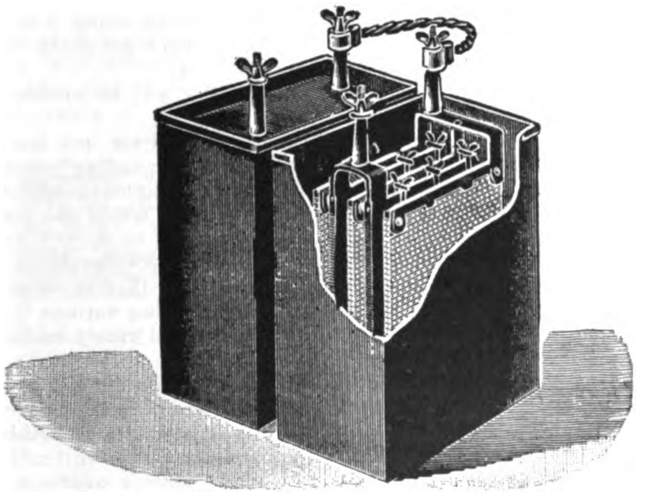


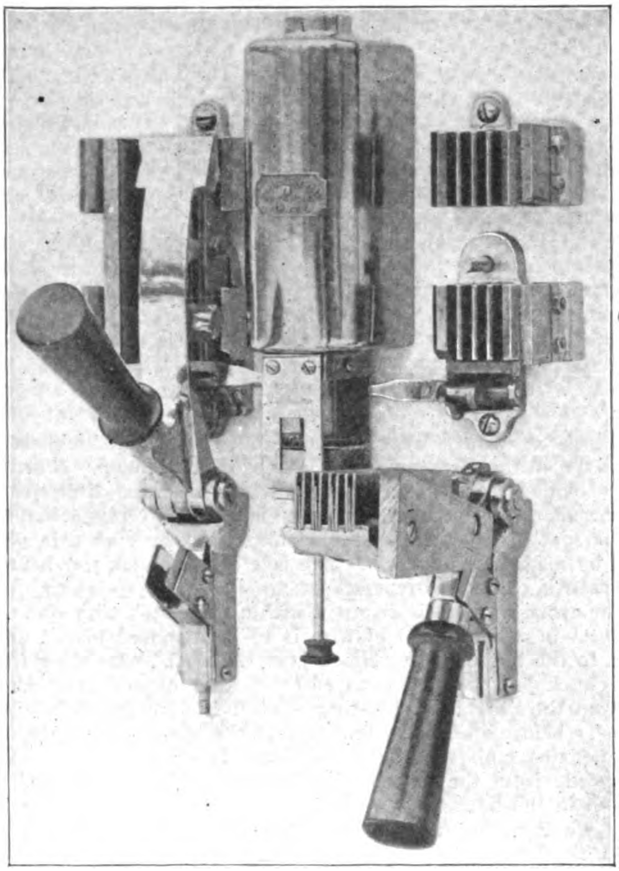
FIG. 2.—LAMINA ACCUMULATOR; RAILWAY TYPE.

way, taking it as being as high as that of any other accumulator, these cells have a greater durability."

Reports of a similar nature have been submitted by Messrs. C. E. Spagnoletti, M. I. E. E., and Haydn I. Harrison, M. I. E. E. The type of cell shown in Fig. 1 is made for lighting purposes, and one of these cells having a capacity of 320 ampere hours, weighs 71 pounds. Fig. 2 shows the motor car type which is incased in ebonite boxes. The total weight of one of these cells having a capacity of 100 ampere hours, is 27 pounds complete.

Ward Leonard D. H. Circuit Breakers.

THE accompanying cut shows the new type of D. H. Circuit Breaker, manufactured by the Ward Leonard Electric Company, Bronxville, N. Y. These circuit breakers are so constructed that each side of the circuit in the double pole type is separately closed. The instant the current flows, the side of the switch not held by the operator will automatically fly open and open the circuit if an overload or short circuit exists. If an overload occurs later, after the operator has left the switch, then both poles will open simultaneously. In both cases the circuit is instantly interrupted, and all the arcing occurs on carbon. The carbon blocks are readily replaced by loosening a couple of screws. The contact blades are detachable by removing one screw, and can be mailed in an ordinary envelope. They are of novel construction insuring perfect contact, and have a contact duty of 50 amperes of current for each square inch of blade surface. The only adjustment is that of raising or lower-



WARD LEONARD ELECTRIC CO. CIRCUIT BREAKER.

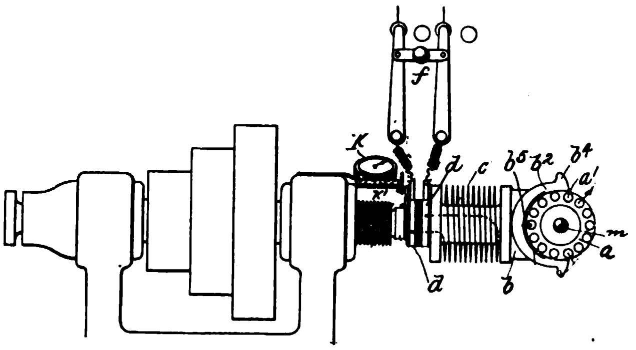
ing the vertically movable core of the solenoid magnet. The adjustment ranges from 25 per cent. under, to 50 per cent. over the current which the circuit breakers will continuously carry. The adjustment readings cover a long range of travel of the core, and are well defined and easily read. This type of circuit breaker is particularly applicable for switchboard work, as all the connections are made on the back.

A prominent electrical engineer of New York City writes in regard to this circuit breaker: "The points of superiority I have noticed are: 1st. Reliability of action; due to having the two independent automatic switches in the one instrument, one for each pole. Also the use of rolling friction in the latches. Also the strong hammer blow positively opening the switches when the latch is released and produced by energy independent of the momentum of the iron core which has merely to release the roller friction latches. 2d. Perfection of switch contact; due to the use of multiple, independent switch blades set into perfectly plane contact by independent springs. 3d. Ease of closing switch; due to closing only one pole of the switch at a

time and also due to the smooth flexible contact. 4th. Safety in closing switch which cannot be closed upon a short circuit or overload. 5th. Cheapness and simplicity of removing all working parts. 6th. Small dimensions often of great importance in switchboard design; also minimum extension from switchboard when open. 7th. Ease of tripping the switch by hand."

Oehring's Winding Device for Small Armatures.

WHAT appears to be a very ingenious device for supporting small armatures during the process of winding, is described and illustrated in a patent just granted to August J. Oehring, of Chicago, Ill. The following abstracts and brief description of the apparatus may prove of interest: Referring to the figure, which is an elevation of a head stock of a lathe with the device in position, the core of the armature to be wound is shown at a, which is constructed of laminæ of sheet iron, the holes and slots of which are aligned in assembling. This forms the longitudinal recess a' in which the armature coils are disposed. An iron chuck b is secured by a brass extension to the live spindle of a lathe, the chuck being provided with a curved jaw b^2, adapted to receive the armature core. The stem of the chuck is surrounded by magnetizing coil of wire c, the



OEHRING'S COIL WINDING DEVICE.

terminals of which are connected to two insulated collecting rings d d, with which a pair of brushes make contact. A switch f is provided, which is adapted to include a source of electricity in circuit with the brushes, rings and coil to magnetize the chuck-jaw, which is thus enabled to secure the core a in position by magnetic attraction. The face of the chuck jaw next to the core is preferably recessed.

The armature core is disposed within the chuck with opposite recesses in which a coil of wire is to be disposed placed adjacent to the lips b^4 of the chuck jaw. A lug b^5, extending from the chuck jaw is adapted to enter another of said recesses to prevent the core from rotating after it is adjusted. While the core is being inserted within the chuck, current through the magnetizing coil c should be broken. The surfaces of the lips b^4 recede from the recesses in the core and are rounded, as shown in the figure.

In winding the armature the live spindle of the lathe is rotated, the armature core being thereby revolved in a plane coincident with its shaft m. The armature wire is attached at one end to the core and is unwound from its bobbin as the core is rotated and wound within the opposite recesses in the core. The wire is held in the hand of the operator in a manner to cause its engagement with the lips of the chuck jaw which guide the wire into the adjacent recesses a'.

To insure an equal number of windings in each coil of the armature, an instrument is provided for measuring the number of rotations of the chuck and contents, which may consist of a cyclometer k, which is actuated by a roller k', mounted upon an arm, projecting from the stem of the chuck. When the cyclometer indicates the predetermined number of revolutions, the lathe-belt is shifted to stop the rotation of the chuck, the core being thereupon readjusted for the winding of the next coil.

MR. W. A. CHAMEN has been appointed city electrical engineer of Glasgow, Scotland, at an initial salary of $4,000 per year. He is 33 years of age, was with Messrs. Crompton and had charge of the construction of the electrical plant of the great Liverpool Street railway station in London.

LETTERS TO THE EDITOR

Some Practical Questions in Electric Motor Business Answered.

YOUR article in The Engineer of Jan. 6, 1898, on page 2, gives a table of the number of motor horse-power furnished by the Edison Electric Iluminating Company in Brooklyn, between Jan. 1, 1890, and Jan. 1, 1898. It seems to me that a very interesting article could be written on this one subject alone; I know that I should be much interested in it, and I believe others would.

1. Such questions as the number of motors in use for different units of power. Of course, in this I should not expect every individual unit to be separated, but that they might be separated into units such as one-half power, or less, one-half to one, one to five, etc.

2. What are the rates paid for motor service?

3. What is the actual amount of power delivered, as compared with the nominal capacity of the motors, or machines using the power.

4. Whether it is best to collect the revenue on the basis of meter rates, or a less rate on the nominal basis of power used.

5. Whether the power actually sold, if on a nominal basis, would not be much in excess of the power actually used.

6. The satisfaction, or dissatisfaction, of the users of power, as compared with power obtained from steam plants.

7. Which is the cheaper in actual cost to the consumers, steam or electric power.

8. Whether the Electric Company to obtain the power had to keep solicitors in the field, showing up the advantages and urging users to change from steam to electric power.

9. What became of the steam plants, when the electric plants were installed.

10. At whose expense was this change made?

11. What would be the diagram for the motor service, subdividing into different industries, if run at different periods of time.

These are a few of the points that occur to me.

JAMES H. HARLOW.

Wilkinsburg, Pa.

The above letter was submitted to Mr. W. S. Barstow, general manager of the Brooklyn Edison Company, who has favored us with the following reply:

On account of the large amount of work which has overtaken us in Brooklyn, I fear we shall have no time to make any special tests on motors, although we contemplate doing it some time in the future. In the meantime I might enlighten Mr. Harlow on some of his questions as follows:

1. This question is not quite clear, and I will be unable to answer it without further explanation.

2. The rates paid for motor service vary from 12c. per horse-power hour to 3c. per horse-power hour, depending on the number of horse-power hours used during the month, and on the two-rate system the hours of the day in which they are used.

3. The actual percentage of motor load to the shop rating of the motors installed is about 33⅓ per cent.; that is, with a connected load of 3,800 horse-power, representing various lines of business, etc., the actual load in the station rarely exceeds 1,200 horse-power.

4. It is no doubt preferable to collect revenue on a meter basis, as a contract system is simply guesswork and obliges the company to keep watch of the individual customers, something which is impossible in a large installation.

5. This question is not quite clear.

6. We have very few cases indeed of disconnection of power on account of dissatisfaction, as parties carefully investigate the question before purchasing the motors.

7. Whether steam or electric power is the cheapest, depends on the business and conditions under which the customer is operating. We have several cases in Brooklyn where the furnishing of steam to an engine not only costs a man nothing, but he would actually lose money if he did not consume his refuse and was obliged to cart it away.

8. It is necessary to keep solicitors in the field continually demonstrating the advantages of electric power over steam.

9. The steam plants are disposed of in some way after the electric plant is installed.

10. All expenses of changing from steam to electricity are borne by the customer.

11. As this question is not clear, I am unable to answer it.

W. S. BARSTOW, General Manager.

Brooklyn, N. Y.

Exhaust Steam Heating.

I NOTICE a brief article by W. B. Lewis on this subject in your issue of Jan. 27. As both "Le Chat" and "Sic. 'Em" seem to have retired from the field I will take the liberty of commenting upon some of the theories of Mr. Lewis. One of these seems to be that with a simple cylinder engine "the initial pressure must be increased to three or four times the back pressure in order to make the engine do the same amount of work as before." I believe this to be a fallacy. Back pressure on a plain cylinder engine is simply an increase of the weight of the atmosphere against which an engine works. When exhausting into the air it works against a pressure of nearly 15 pounds. That is the difference between the atmosphere and a vacuum. With 5 pounds back pressure, the engine works against an atmosphere of 19 pounds. No matter what the theories are, I know that in practice this rule holds good. I am familiar with several of the large exhaust plants operating under the Holly System. Mr. Lewis will not get any support for his theories from the engineers or managers of any of these plants. One plant heats 10,000,000 cubic feet of space with exhaust steam. The engines used are both compound and single expansion. With from 2 pounds to 5 pounds back pressure on their nine engines the engineer says: "We do not notice any difference in the working of our engines." The manager of another plant which runs six engines aggregating 1,000 horse power and carries 3 pounds to 5 pounds back pressure, says that by increasing the initial pressure by the same amount "the efficiency of the engines was not impaired." Another manager running six engines says "they run smoother under back pressure than without."

This seems to be the universal testimony, that an engine working under back pressure never pounds, and works smoother under a maximum load. Theory is well enough where practical results are not attainable. but must yield to facts in actual practice.

Mr. Lewis's dictum that "the only way to heat by exhaust steam is to use a vacuum system" by itself, would not be very convincing unless he is speaking from experience. The vacuum plan is made to work quite well in single buildings, but in a system where a large number of customers are served, as must be the case where the exhaust from large power stations is utilized, it would be idle to attempt it. A leak in a single service pipe. or a failure at some point not easily accessible would for the time cripple the whole plant.

I. H. B.

February 3, 1898.

LITERATURE

FIRST REPORT UPON MAGNETIC WORK IN MARYLAND, INCLUDING THE HISTORY AND OBJECTS OF MAGNETIC SURVEYS. By L. A. Bauer. Maryland Geological Survey. The Johns Hopkins Press. Baltimore, 1897.

The title of this brochure sufficiently explains its contents. and as we have already placed the main points on which it treats before our readers, it is not necessary to repeat them. Suffice it to say that this report is a model of its kind in every way, both as to literary style and typographical get-up. The magnetic maps are carefully worked out and the description of the instruments employed and their method of handling ought to be most helpful to others designing to undertake similar work. Our various State surveys have been lamentably behind in magnetic work. and Maryland has set an admirable example in this respect.

TELEPHONY AND TELEGRAPHY

Telegraph Privileges to the Federal and Western Union Lines in Mexico.

The Mexican government has published an order to the Mexican National Railroad Company, and the Mexican Central Railroad Company notifying them that they must discontinue handling commercial and other telegraph messages between the United States and Mexico, on the ground that the class of telegraphs which the railroads are entitled to establish and operate is clearly defined in Article XIV of the Regulation Law, of December 7, 1867.

The effect of the order, if fully carried out, means that the telegraph service in Mexico must be carried over the Federal lines. Under a contract between the government and the Mexican Telegraph Company, operating by cable from Galveston to Vera Cruz, and with the Western Union from Láredo and El Paso, all international telegrams will be carried by those companies.

The officials of the Postal Telegraph Company, in this city, say that their company received information some time ago to the effect that the Mexican government had entered into a contract of exclusive connection with the Western Union Telegraph Company for the exchange of. commercial telegraph business with the Federal lines of Mexico, and that the effect of this contract, if carried out, would be to prevent the railway companies, who own their telegraph lines, from transmitting commercial business, which they have contracted to exchange with the Postal Company. The Postal officials further explain that the railway companies claim that their concessions from the Mexican government as clearly confers upon them the right to transmit commercial telegraph business as to operate their railways; that the constitution of the Mexican government distinctly prevents the establishment of a monopoly within the Republic of Mexico; that the action proposed is a discrimination in favor of one corporation against another; that it is in restraint of trade, and against public policy, and that they are in communication with the Mexican government, with the view of maintaining these rights, both in the United States and in Mexico.

An Interesting Telephone Anniversary Dinner At New Haven, Conn.

The president and directors of the Southern New England Telephone Company celebrated the 20th anniversary of the opening of the first telephone exchange in the world by giving a dinner at the New Haven House, New Haven, Conn., Friday night, Jan. 28.

Among the guests were Charles F. Cutler, president of the New York Telephone Company, who was concerned in the organization of the earliest telephone companies in Massachusetts; William D. Sargent, vice-president of the New York and New Jersey Telephone Company, who was engaged in the early establishment of the Philadelphia exchange; D. I. Carson, who since 1879 has been engaged in the development of the Southern Atlantic States with the Southern Bell Telephone Company; Samuel Ivers, treasurer of the Southern Massachusetts Telephone Company, a pioneer in his locality; Thomas D. Lockwood, one of the oldest and ablest electrical experts of the American Bell Telephone Company; Gen. E. P. Meany, of New York, the man to whose efforts is largely due the extension of the long distance lines; W. J. Denver, manager of the New England Telephone Company; Joel C. Clark, Morris F. Tyler, A. L. Salt, W. N. Eastabrook, A. C. White, G. S. Pond, E. J. Pittman, C. B. Doolittle, Henry L. Storke. J. English, S. E. Merwin, E. N. Clarke, F. A. Allan, W. G. Riggs, A. F. Lincoln, J. W. Alling, H. F. Stevens, Geo. E. Betts, W. N. Sperry.

The dinner was purely a friendly affair. There were no toasts, but the development of the telephone was interestingly discussed, and a number of amusing stories were told. The menu cards were artistic and unique. On the third page was a fac simile of one of the first telephone lists issued. It contained 50 names. On the fourth was a photo fac simile of the first and only telephone bill ever paid by President Morris F. Tyler, of the Southern

New England Company. It is dated Feb. 27, 1878, and shows that he paid $9 for six months' service to the District Telephone Company.

Concessions to Canadian Telegraphers.

W. H. Allison, chairman of the Canadian Pacific Railway Telegraphers' Committee, recently in conference in Montreal with the officials of the company in reference to the annual agreement, has issued a circular reciting the concessions made by the railway company, as follows: (1) The right of trial or investigation in case of discharge or suspension. (2) Telegraphers are not to be discriminated against for serving on boards of adjustment. (3) Rights of promotion. (4) Telegraphers will be allowed to attend their annual or regular meetings. (5) No telegrapher will be required to teach the art of telegraphing. (6) Extra pay for attending switch and semaphore lamps. (7) Telegraphers will not be required to shovel snow, sift ashes, or scrub stations. (8) Commissions to be paid on commercial business. (9) Twelve consecutive hours to constitute a day's work. (10) Overtime after twelve hours. (11) Telegraphers will be exempt from Sunday work as far as possible. (12) Telegraphers in the service for four years or more will be entitled to two weeks' leave of absence each year, together with full pay. (13) Minimum salaries range from $38 to $50 a month, in some cases including dwelling, fuel, and light, and some relieving agents being allowed 50 cents per day extra for expenses. Several thousand dollars of individual increases were also secured, and the company agreed to place extra men at several points during the busy season.

MECHANICAL

Physical and Chemical Properties of Volatile Oils in Boilers[1]—II.

(Concluded.)

BY W. H. EDGAR.

NOW, why do people want to use kerosene? It is generally the man up at the office end of the institution that clings to the practice; it is generally the superintendent or the manager that clings to kerosene, because it costs nothing; he is getting something for nothing. That is where so many men have made a mistake even in the running of large enterprises and large businesses. One of the greatest dangers is to look for something for nothing. Even in the hiring of men to represent them and in the hiring of help; in the hiring of brains around their establishment, they are not willing to pay; they want ten dollars put in their hands before they will give eight dollars; a man cannot do that in business. You cannot get something for nothing, and you cannot get any man to run his business without profit. This is true of boiler compounds, which to the modern steam plant owner is far behind all other branches of science. If you will in using kerosene or using any volatile oil of that nature whatever, take the subject up and look into it for yourselves, you will find that the deleterious effects, the general carbonizing and pitting, the general eating away of that thin natural skin of the iron (the finish as it comes from the boiler maker) is a dangerous thing. It takes several years to scale a boiler to start with, on a fairly good water, but if it is scaled once it will scale again in three months, because the skin of the iron is gone. When the skin of the iron is once gone, the scaling ingredients readily attach themselves to the rougher iron, while in the new boiler they cannot adhere as rapidly as they can in the boiler where the skin is gone.

In the discussion which followed, Mr. Edgar elaborated his very interesting address by the following remarks:

Speaking of vegetable compounds, we should use sugars and tannins only and in this way as follows: We find that we can take care of the carbonates of lime and magnesia with tannin extracts and that is what we want; we do not want the extracted tannic acid. We want the tannin in the extract form and still combined and containing the inert matter, the sap, the sugar and the starch. We want that because we do not want the straight pure tannic acid. It is too stable in itself to be readily convertible into tannates. Our object is to convert carbonates of lime and magnesia into tannates. Now we find that we cannot work on gypsum, the sulphate of lime with tannin. We find that gypsum is one of the four insoluble sulphates and that it is so stable in itself that it is not even soluble in its own acid and is soluble only in the analytical laboratory in small quantities in hydrochloric acid.

We find that sugar introduced into the steam boiler with the water will convert the sulphates into saccharates. The saccharates break up into oxalates, tartrates and carbonates; and in the presence of tannin extracts, part of that goes into tannate of lime, so that we need but a small proportion of sugar present in the general mixture to handle a water containing both the sulphates and the carbonates. Your sulphates and carbonates are to be proportioned according to the percentage of the carbonate and sulphate contained in the water determined by analysis.

Under no circumstances should kerosene oil be put in the boiler. I would make the same remark in regard to caustic soda.

In answer regarding steam heaters: I think one of these steam heaters is a good thing on hard water for you get from 50 to 70 per cent. out. If a water is so soft that you get all the impurities out, it becomes too pure and you pit your boilers. Water is a great solvent. In the East where the soil is principally granitiç there is very little scale, only about two or three grains to the gallon; but throughout the West, where there is a limestone soil, you get from 16 to 40 grains.

A surface blow-off contrivance is very good, but the trouble is, they are expected to do all the work and sufficient interest and care is not usually taken in the application of such contrivances. The boiler is too often neglected and it cannot get up and speak its piece like the engine, when anything is wrong. You must diagnose your case and work out your own ideas.

Do not forget to treat the boiler regularly. Put in whatever you use, regularly. Have the water analyzed and go to the wholesale druggist and he can mix up the tannins and sugars in proper proportions, but do not use any soda. Some sulphate waters require considerable starch, slippery elm, etc.; they sometimes use five or six per cent. of carbonate of soda in boiling it together which kills the gelatinous properties, and then when you introduce your tannin extract, the carbonate is converted into tannate of soda; five per cent. tannate of soda, 20 per cent. of sugar and 50 per cent. of tannins. The steam users in the country should look into this thing and should study their boilers. There is an article on the impropriety of the use of caustic soda, in the October issue of the National Engineer. Also on "Water," in the December issue.

The greatest point in regard to compounds is the care given to the boiler.

You should get the engineer interested in the matter.

[1]Abstract of an address before the Northwestern Electrical Convention, Milwaukee, Wis., January 20, 1898.

PERSONAL

Tyndall's Bequest to the Royal Institution.

Mrs. Tyndall, the widow of Prof. Tyndall, according to "Nature," has sent the following letter to Sir James Crichton-Browne, F. R. S., the treasurer of the Royal Institution: "Dear Sir James:—As an expression of his attachment to the Institution, with which he was so long connected, and of his sympathy with its objects, my dear husband desired me (at such time as should be most convenient to myself) to present in his name to the Royal Institution £1,000 ($5,000), to be disposed of as the Board of Managers may see fit for the promotion of science. I have now the pleasure of remitting to you this sum. Yours faithfully, Louisa C. Tyndall." Sir James Crichton-Browne, in the course of his letter acknowledging this generous donation, remarks: "The managers would, I am sure, desire to be guided by any wish of yours as to the application of the gift; but, in the absence of any explicit directions, they will, I have no doubt, employ it in the promotion of that original scientific research in which your husband's vivid and penetrating intellect delighted to exercise itself. Revered as your late husband's memory is,

and ever must be, in the Royal Institution, this posthumous mark of his solicitude for its welfare will, if possible, deepen the affectionate esteem in which he is held."

MR. N. W. PERRY, of Westinghouse, Church, Kerr & Co., has, we regret deeply to hear, been ordered by his doctors to abstain from work for awhile in order that his health may improve. It is to be hoped that he may soon again be in shape to resume active work.

SOCIETY & CLUB NOTES

Important Meeting of the New York Electrical Society.

A very interesting meeting of the New York Electrical Society will be held at the College of the City of New York at 8 P. M. on Friday, Feb. 11, when papers will be presented by Mr. Joseph Wetzler on "Electricity Direct From Coal," and by Prof. George F. Barker and Dr. Edgar Smith on "Important Aspects of Electro-Chemistry." The meeting will be a joint one with the New York section of the American Chemical Society.

Webster Lecture Before the Röntgen Society.

BEFORE the Röntgen Society, on Tuesday evening, Jan. 11, under the presidency of Prof. Silvanus Thompson, a paper was read by Mr. W. Webster, F.C.S., on "Practical Work with the X-rays." He first dealt with the question of the best apparatus to use, and pointed out the value of primary batteries. Mr. Webster then pointed out how much had been done by Sir William Crookes and Mr. Jackson, and remarked that Dr. Röntgen had merely put the finishing touch to their discoveries. He showed the tube which had been made by Mr. Jackson in 1894, with which he had demonstrated that wood and other materials were pervious to certain rays. He had found an improvement to prevent the spark from passing round the bowl of the tube, and thus lessening the danger of perforation. By heating the tube and starting with a small spark he was able gradually to produce the effect he wished, and had thereby saved the lives of many tubes. The bulb of the tube should not be very large, as the larger it was the more difficult the tube was to condition, and the greater were the number of accidents. An aluminum cover for the cathode tube was an advantage, and a protector of sheet iron was useful for saving the hands from the effect of the rays. The effect of the rays varied very much with different subjects. In the case of one patient, whose head was photographed, a patch of his hair first turned gray and then came out, and he was not grateful to the rays; however, the hair had grown again afterwards of the original color. In other cases, however, the pain in the injured or diseased part had entirely ceased after five or six minutes' exposure to the rays. Anæmic subjects were the best to photograph, while gouty subjects were particularly difficult. To produce good negatives, considerable experience in photographic development was necessary, especially in the production of cloud negatives.

MARRIED

Dallas—Desvignes.

The marriage is announced in London of Mr. James Douglas Dallas, of Egerton Gardens, S. W., to Antoinette Charlotte, daughter of Commander Doré D. Desvignes, of Milan, Italy, and his wife, née de Valcourt. Mr. Dallas was at one time engaged in electrical engineering work in the United States, making many friends who will wish him all prosperity in his new relationships and in his professional work at home in England.

REPORTS OF COMPANIES

Stanley Electric Manufacturing Company.

The annual meeting of the Stanley Electric Manufacturing Company, of Pittsfield, was held January 25, 1898, and the reports were gratifying. The business of the past year has been very prosperous, and for a good part of the time their extensive shops have been run overtime. The shipments show a decided increase over last year, or about 12½ per cent., and more orders to begin the new year with than they have ever had before. The gross profits for the year are reported at over $100,000. A dividend of 6 per cent. was declared, payable April 1, to stockholders of record January 25. The stock is quoted at 130. Pittsfield is pleased with the prosperous company in its midst doing a business the past year of about $600,000. The old officers were elected as follows: President, W. W. Gamwell; treasurer, George W. Bailey; general manager, John H. Kelman; general superintendent, Henry Hine; electricians, C. C. Chesney and John F. Kelly; directors, William F. Gamwell, William A. Whittlesey, William R. Plunkett, Walter F. Hawkins, Henry Hine, George H. Tucker and George W. Bailey. The company's machines are in active demand, going to foreign countries, including Japan, and four large ones were shipped to California yesterday. The company also maintains a large shop in Canada for English and Canadian trade.

Annual Report of the New York Edison Ill. Co.

WE give below an abstract of the interesting and important annual report of the New York Edison Company, as made by First Vice-President R. R. Bowker. The figures are also considered editorially this week:

This company, which first sold current in 1882, had on January 1, 1890, 1,200 customers and installations of 39,815 incandescent and 77 arc lamps and 421 horse power in motors, being the equivalent of 46,900 16-candle-power lamps. Its maximum output was 12,000 amperes (estimated); it had $2,850,000 loan and share capital; its gross income for the previous year was $329,773 and its net $124,031 or 38 per cent. After eight years of development, it has now (January 1, 1898) 7,313 Edison customers, and installations of 346,723 incandescent and 4,775 arc lamps and 19,364 horse power in motors, being the equivalent of 696,370 16-candle-power incandescent lamps, exclusive of 60,068 high-tension and 80,928 breakdown connection, equivalent in all to 837,366 16 candle power. It reached, in 1897, 100,000 amperes maximum output; it has $14,500,000, in round numbers, loan and share capital; its gross income for combined systems was, in 1897, $2,486,636, and its net, without depreciation charges, $1,261,497, or 50.7 per cent., or deducting depreciation charges, $1,117,497, or 45 per cent. The progress in eight years shows six times the number of customers, seventeen times the installation, eight times the maximum output, on but fivefold the capital, with over seven times the gross and nine times the net income. In the eight years no previous year has shown so great an increase as 1897, in which the number of customers has been increased 751, the number of Edison lamps 67,318, the number of arc lights 1,550, the horse power in motors 3,433, and the installation equivalent 136,028. For the Edison system only the gross station returns have increased 13.7 per cent., and the general and operating expenses have increased 10.9 per cent. It is especially remarkable that this development has taken place with so small an increase in the investment account, the extensions of the system having been confined during the present year to additions to the generating plant requisite to maintain the proper reserve, the extension of the feeder system to points where was indicated increasing demand, and the extension of the mains only to points where that demand was definitely promised.

The following table shows the net increase in the several classes of installation and in earnings in the past year, reckoning a standard arc lamp as the equivalent of ten 16-candle-power incandescent lamps and a horse power in motors as the equivalent of fifteen 16-candle-power incandescent lamps, the basis

agreed upon by the leading Edison companies for reckoning such equivalents:

	1897. Dec. 31.	1896. Dec. 31.	Increase in one year.	Perct. Inc.
No. customers	7,313	6,562	751	11½
No. inc. lamps	346,723	279,405	67,318	24
No. arc lights	4,775	3,225	1,550	48
No. motors, h. p.	19,364	15,930	3 433	21½
Total equiv. 16 c. p.	696,370	560,342	136.028	24⅓
Gross station returns †	$2,015,102 09	$1,771,229.83	$243,872.26	13¾
Gen. and oper. expenses*	929,263.87	836,396.77	92,867.10	11
Net station returns †	1,085,838 22	934.833.02	151,005.16	16
Prop. expense* to gross†	46%	47%		

*Exclusive of depreciation charges. †Not including outside earnings.

The figures include only Edison central station direct service.

The following table gives the figures inclusive both of Edison central station service and of isolated plant installations supplied from the Edison stations during minimum hours or for emergencies:

	Central Station Service.	Isolated Plant Service.	Total Service.
Customers	7,313	74	7,387
Meters	9,826	115	9,941
Incandescent lamps	346,723	56,341	403,074
Inc. lamps, 16 c. p. equiv	354,740	59,578	414,318
Arc lamps, number	4,775	692	5,467
Arc lamps, 8 ampere equiv	5,117	692	5,809
Motors, h. p. equiv*	19,364	962	20,326
Total equivalent	696.370	80,928	777,298

*Miscellaneous equipments, such as heaters, organ control, physicians' apparatus, etc., are included in h. p.

The isolated plant service or emergency connections show lower figures this year, in part because a number of isolated plants have been shut down and are now taking central station service.

These figures do not include those of the high-tension companies operated under the supervision of this company and constituting practically the high-tension division of this company. These companies had on their station service December 31, 1897, 35,568 incandescent and 2,426 arc lights, and 16 horse power in motors, or an equivalent of 60,068 16-candle-power, which, added to the Edison station service, gives a total of 756,438, or, with isolated plant service, 837,366 16-candle-power equivalent.

The equipment at the Duane Street Station was increased during 1897 by the addition of one B. & W. 553-horse-power boiler, one Southwark 2,500-horse-power quadruple expansion engine, and two General Electric 800-kilowatt dynamos, making the total equipment at the Duane Street Station at this date, in boilers, 5,050 (rated) horse power; engines, 11,800 horse power and dynamos, 7,600 kilowatt.

The Bowling Green Storage Battery Annex, supplementing the Duane Street Station, has a storage battery capacity of 8,000 ampere hours at a ten-hour discharge rate, or 4,000 amperes at 125 volts for one hour.

The equipment at the 12th Street Station was increased during 1897 by one B. & W. 333-horse-power boiler, one McIntosh & Seymour 1,250-horse-power triple expansion engine, and two General Electric 400-kilowatt dynamos, making the total equipment at the 12th Street Station at this date, in boilers, 1,332 (rated) horse power; engines, 2,500 horse power; dynamos, 1,700 kilowatt, and a storage battery, with a capacity of 8,000 ampere hours at a ten-hour discharge rate, of 4,000 amperes at 125 volts for one hour.

At the 26th Street Station, two McIntosh & Seymour 250-horse-power engines and four 100-kilowatt dynamos were replaced by one Southwark 1,250 horse-power cross-compound engine and two General Electric 450-kilowatt dynamos. Its equipment at this date is, in boilers, 2,576 (rated) horse power; engines, 4,550 horse power, and dynamos, 3,300 kilowatt.

The 39th Street Station maintained its previous equipment, its capacity being as last year, 1,630 (rated) horse power, in boilers; engines, 2,400 horse power, and dynamos, 1,840 kilowatt.

At the 53d Street Station, one N. Y. S. 200-horse-power engine driving one 60-kilowatt and one 100-kilowatt dynamos were replaced by one McIntosh & Seymour 250-horse-power engine, and. two 100-kilowatt dynamos, transferred from 26th street. The equipment consists of, boilers, 1,123 (rated) horse power; engines, 1,300 horse power; dynamos, 1,080 kilowatt; and a storage battery, having a capacity of 2,600 ampere hours at a ten-hour rate.

The 72d Street Annex Station is supplied by the Manhattan Company from its main station at the foot of 80th street, with high tension current, operating a 240-kilowatt motor at 2,000 volts, which drives two 100-kilowatt Edison 135-volt direct-current dynamos.

The mileage of the underground street system December 31, 1896, was, on the 3-wire system, 70.67 miles of feeders and 138.49 miles of mains, a total of 209.16 miles of the 3-wire system; and on the 2-wire system, 0.17 mile of mains. The total mileage December 31, 1896, including 2.43 miles of cable feeders, was 209.33 miles of mains and feeders. The system also included December 31, 1896, 1,208 junction boxes at intersections.

During the year 1897, in the downtown district, 3.29 miles of 3-wire feeders have been laid, and 0.53 removed, an increase of 2.76; and 2.93 miles of mains have been laid, and 0.81 mile removed, making an increase of 2.12 miles. Of the old 2-wire system in the downtown district 0.02 mile of mains has been removed. This leaves but 0.15 mile of mains of the old 2-wire system. The net increase in the first district is 4.86 miles.

In the uptown district 5.04 miles of feeders have been laid and 1.32 removed and 4.85 miles of mains laid and 0.97 removed making an increase of feeders of 3.72 miles and in mains of 3.88 miles, a net increase of 7.60 miles, all 3-wire, in the second district. The removal of feeders and mains uptown was chiefly due to replacement with larger conductors of the small tubing used in some streets when the uptown system was first laid.

The greater part of the feeder system laid during the year consisted of cable feeders, of which there were 2.83 miles laid in the downtown district and 4.22 miles in the uptown district, and none removed; making a total increase of 7.05 miles. As there was a total decrease of 0.57 mile of tube feeders, the net increase in the feeders of both districts amounted to 6.48 miles.

The net increase of the system, in both districts, is 12.46 miles, bringing the grand total December 31, 1897, to 221.79 miles. The increase in junction boxes has been 42, making a total of 1,250.

The number of service connections added during the year was (net) 377 in the downtown district, and 567 in the uptown district; in both 944.

The Inspection Department has continued its successful work, combining as hitherto the functions of the general agency with those of general inspection. During the year 235 contractors have reported installations, involving 3,265 reports. Of these, 18 have reported installations reaching over 1,000 incandescent lamps in the year past. Of electric motors, which have continued to show marked development, 58 types have been installed on the system, numbering 1,574 motors, averaging 3 horse power each and aggregating 4,737¾ horse power. The special development of the year has, however been in the increase of enclosed arc lamps, of which 1,633 have been added in 1897 to the system. The figures represent the total additions, without deducting changes and withdrawals.

The Meter Bureau, under the general charge of the Controller, has continued its excellent efficiency during the year; it had under its care on December 31, 1897, 9,941 meters, of which 6,744 were Edison chemical meters and 3,197 mechanical meters. The usual careful attention has been given to complaints from customers, as to amount of bills, etc., of which 1,530 were received during the year. In connection with these complaints there were found 215 errors, of which 138 were clerical and 77 technical. The proportion of errors to bills rendered was 1 in 511, or less than ⅕ of 1 per cent., an increase of proportion above that of 1896, due in large measure to the extensive change from chemical to mechanical meters, involving a considerable strain on the Meter Bureau. There is reason to hope that the proportion will be considerably reduced in another year. The company continues its policy of offering to submit any disputed case to arbiters, and in general has succeeded in showing to customers its desire to treat every one with entire fairness.

The report then discusses at length the reduction of rates which is noted editorially in The Electrical Engineer this week.

The development of the enclosed arc lamp has not only led to a great extension of the low-tension arc light service, which shows an increase from 3,225 to 4,775 in 1897, but has made possible a remarkable development of low-tension street lighting. After a careful collation of views and plans of arc lamp posts used in various cities here and abroad, the Engineering Department designed a new form of post, for city lighting, of artistic pattern, which has met with general approval. This post bears on its base the arms of the city and the seal of the Edison Company, and is surmounted by a graceful curve in place of

the awkward yard arm, and a view of it, as also of the latest pattern of the twin-lamp post used on Fifth and Madison avenues, is given with this report. These enclosed arc lamps burn approximately 100 hours without retrimming, permitting a considerable saving in both carbons and labor, so that the same price could be made to the city as for high-tension street lamps, namely, 40 cents per night, which averages less than 4 cents per hour of service. Of these lamps 236 have been installed in the streets during the past year, and 300 more are included in the plans for city lighting for the coming year. The company has undertaken the lighting of the Seventh and Ninth Regiment Armories, and of other city buildings, with incandescent lamps, and it is expected that other public edifices will hereafter be lighted by electricity instead of gas.

The relations with employés have continued to be thoroughly satisfactory. The Labor Benefit Fund, now put on a definite and permanent basis, has not only provided for the payment of benefits to employés, ranging from 4 per cent. on the annual salary or wages, to those in the employ of the company for ten years, to 1 per cent. to those of one year's service, but has permitted a wise liberality on the part of the company in cases of fatal or disabling accidents, where no legal technicality was involved.

It is the practice of the company to give careful attention, in a systematic manner, to the salaries and wages of each person in the company's employ, regularly before the opening of each fiscal year, and also semi-annually and quarterly as occasion required. All questions of salaries and wages are brought before the executive in careful reports from the respective heads of departments or superintendents, showing the length of service of the employé, his original remuneration, his last increase of pay and the proposed increase, and these recommendations are made the subject of careful comparison, not only with the compensation given in similar positions in the several departments of the company, but with the rates of salary or wages prevailing outside the company. Thus the employés feel assured that their services are fairly considered, and the question of their pay regularly brought to attention, without effort or appeal on their part, and this method of handling rates of pay has helped to bring about the present satisfactory relations between the company and its employés.

The use of electricity for heating and cooking has shown some, though not great development, and it is hoped that reductions of rates will stimulate this use. The electrical kitchen in the company's building in Duane street, from which the Friday staff luncheon is always served, has been a useful object-lesson of the simplicity and convenience of cooking by electricity, and an illustration showing the neatness and compactness of this method, is given with this report. The use of electric carriages, carrying storage batteries which are charged from this company's system, has become a part of the public cab service in New York, and the company is planning for supply connections in the street, with automatic meters, which may permit more general use of electric vehicles.

The officers and superintendents of the company have rendered most efficient service during the year, as is evidenced by the satisfactory results of the company's business. It is my great satisfaction to acknowledge that these results have been reached, by the co-operation of the employés in the humblest posts, each in his measure, as fully as by that of the most important officer. The company's development has steadily outrun the estimates of growth, and it is evident that the 1,000,000 16-candle-power equivalent installation point will be reached by 1900. In view of this phenomenal growth, the company's engineers have for the past year again been giving most careful attention to the problems of the future, and are reaching results and working out plans for the new century which will doubtless commend themselves to the judgment of those most concerned, when they are ready for publication.

MR. GUSTAV BISSING, principal examiner in the U. S. Patent Office, Electrical Division A, has resigned and has entered into partnership with Mr. Joseph Lyons, the well-known mechanical and electrical expert and patent solicitor, of Washington, D. C. The firm will continue to engage in the practice of patent law in all its branches. Its new offices will be situated in the McGill Building, 908 G street, N. W., Washington, D. C.

INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents issued January 18, 1898.

Alarms and Signals:—

ELECTRIC LOCK AND SYSTEM OF ELECTRIC LOCKING FOR SECURING ADDITIONAL SAFETY IN RAILROAD SIGNALING. J. F. W. Morris & G. Mumford, London Eng., 597,650. Filed Oct. 16, 1896. Enables the signal to be put to "danger" and when the train has been examined the signal can be lowered to allow it to proceed and without giving power to clear the road until the train has been properly disposed of.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. A. Mougin, Paris, France, 597,424. Filed Feb. 13, 1897. Feed mechanism adapted with slight modification to continuous and alternating current arc lamps.

FILAMENT FOR INCANDESCENT LAMPS. F. E. W. Bowen, London, England, 597,492. Filed Aug. 17, 1897. The borate of a refractory metal is incorporated in the body of the filament.

ELECTRIC ARC LAMP. E. Blaser, California, Mo., 597,601. Filed July 15, 1897. Embodies an expansion-wire casing, consisting of two longitudinally-split tubes, one arranged within the other with the outer tube turnable on and adapted to close the inner tube, and perforated insulating-blocks in the inner tube.

Miscellaneous:—

ELECTRIC FURNACE. T. L. Willson, New York, 597,476. Filed Nov. 15, 1895. Designed for such electro-metallurgical reductions as calcium carbid.

APPARATUS FOR PRODUCING OZONE OR OZONIZED AIR. A. Verley, Paris, France, 597,517. Filed Feb. 17, 1897. Comprises two flat horizontally disposed plates arranged face to face with a small space between and constituting the electrodes, and means for projecting jets of compressed air against the upper surface of the upper plate.

REFRIGERATING APPARATUS. W. F. Singer, New York, 597,532. Filed April 5, 1897. Comprises a gas pump, the rotor of an electric motor connected thereto, a hermetically sealed casing inclosing the pump and rotor, and the stator of the motor located exterior to the casing.

MACHINE FOR ASSORTING CARBONS. H. S. Hart, Chicago, Ill., 597,646. Filed Aug. 2, 1897. Comprises a table and means for rolling the carbons over the table in combination with devices for gaging the imperfections of the carbons and ejectors controlled by the gaging devices.

Railways and Appliances:—

ELECTRIC CAR BRAKE. C. F. De Redon, New York, 597,432. Filed Sept. 22, 1896. Stationary electromagnets at opposite sides of the car, pivoted brake arms at the ends of the electromagnets, and air-brakes pivotally secured to arms and held normally upward by means of springs.

ELECTROMAGNETIC RAILWAY CAR BRAKE. C. F. De Redon, New York, 597,433. Filed April 22, 1897. The brake mechanism is in duplicate, one set being at each side of and connected to the car frame.

TROLLEY CAR. J. D. Hull, New York, 597,467. Filed Feb. 1, 1897. Automatic reel for trolley ropes designed to maintain the proper tension.

CONDUIT FOR ELECTRIC RAILWAYS. C. V. Osborn, Dayton, Ohio, 597,508. Filed July 18, 1896. Consists of two side walls bolted together, brackets limiting the width of the conduit and supporting the surface plates.

ELECTRIC TROLLEY DEVICE. G. Valley, Johnstown, Pa., 597,516. Filed March 8, 1897. Comprises a fixed and a movable base having registering recesses, a key mounted on a shaft and adapted to engage the recesses, and a trigger fastened to the shaft adapted to engage the trolley arm when in a given position.

TROLLEY WHEEL. H. B. Sawyer, Chicago, Ill., 597,693. Filed June 19, 1897. Consists of the elongated hollow body having centrally and inwardly directed end grooves.

Regulation:—

REGULATION OF DYNAMO ELECTRIC MACHINERY. F. A. Johnson, Binghamton, N. Y., 597,418. Filed April 1, 1897. Consists in varying the total flux through the armature, to vary the speed of the motor, and maintaining at all speeds a strong field at those portions of the pole-pieces under which the commutation takes place.

REGULATION OF DYNAMO ELECTRIC MACHINERY. F. A. Johnson, Binghamton, N. Y., 597,419. Filed April 24, 1897. Similar to above.

Switches, Cut-Outs, Rheostats, Etc.:—

RHEOSTAT. M. Norden, New York, 597,470. Filed April 12, 1897. Combines with two or more rheostats having contacts in circles, of arms and concentric shafts carrying such arms, a switchboard through which the concentric shafts pass and hand-wheels upon the outer ends of the shafts for adjusting the contact arms.

ELECTRIC SWITCH. E. M. French, Stoughton, Mass., 597,642. Filed Sept. 16, 1897. Means whereby the illuminating devices in the main line circuit may be controlled by push-buttons in a local battery circuit, without carrying the heavy main line wires into a building.

CIRCUIT BREAKER. F. C. Robertson, Toronto, Canada, 597,700. Filed July 22, 1895. Adapted to any telegraph, telephone or similar low-voltage electric circuit.

Telegraphy:—

SIGNAL-TELEGRAPH. C. V. Boughton, Buffalo, N. Y., 597,536. Filed Dec. 19, 1895. Consists of two series of lamps of different colors secured alternately upon a shaft, the lamps of one color representing dots and the lamps of the other color representing dashes.

TELEGRAPHIC SIGNAL. J. Nicolson, Buenos Ayres, Argentina, 597,587. Filed Feb. 26, 1897. Telegraph signals, having an uneven number of elementary motions for the vowels and accented vowels of the alphabet, and an even number of such motions for the consonants of the alphabet.

KEYBOARD TELEGRAPHIC TRANSMITTER. S. Price, Paterson, N. J., 597,689. Filed June 17, 1897. Details of construction.

Telephones:—

COIN CONTROLLED APPARATUS FOR TELEPHONES. W. Gray, Hartford, Conn., 597,556. Filed December 20, 1889. Comprises a signal device located adjacent to the transmitter, a sound deflector leading from the signal box to the transmitter, a spring lock tumbler, a coin controlled signal rod normally locked, and the signal sounding mechanism.

Classified Digest of U. S. Electrical Patents Issued January 25, 1898.

Alarms and Signals:—

ELECTRIC SIGNALING DEVICE. E. A. Stout, Jr., Philadelphia, Pa., 598,033. Filed March 23, 1897. Comprises a plurality of contact points, a combined push button and indicator carrying a contact arm which may be rotated to make contact with the different plates.

ELECTRIC BURGLAR ALARM SYSTEM. C. Coleman, Chicago, Ill., 598,049. Filed December 14, 1896. Details of construction.

DEVICE FOR PREVENTING ACCIDENTS ON RAILROADS. H. Biermann, Breslau, Germany, 598,062. Filed April 6, 1896. Means to actuate by electricity the alarm and safety apparatuses of the train when a rail has broken or a fish-plate is loosened before the train has reached the defective spot.

ELECTRIC BURGLAR ALARM SYSTEM. C. Coleman, Chicago, Ill., 598,063. Filed December 14, 1896. Details of construction.

Batteries, Secondary:—

MANUFACTURE OF STORAGE BATTERY GRIDS. W. W. Griscom, Haverford, Pa., deceased, D. I. H. Griscom, executrix, 597,846. Filed November 22, 1895. Comprises a stationary mold, a ladle and connections between the mold and ladle, permitting the ladle to be moved above and below the plane of the mold.

Conductors, Conduits and Insulators:—

ELECTRIC CABLE. W. S. Smith and W. P. Granville, London, Eng., 597,790. Filed November 1, 1897. Composed of a tubular case enclosing a cylinder which is built up of two or more segments, and has a longitudinal central hollow air space and also has one or more wires embedded in each segment, such segments being twisted as they are brought together and before the outer covering is formed around them.

Electro-Metallurgy:—

ART OF OBTAINING GOLD AND SILVER FROM AURIFEROUS AND ARGENTIFEROUS MATERIALS. N. S. Keith, Chester, Eng., 597,820. Filed February 21, 1895. Consists in first dissolving the metal in a solution containing cyanid of mercury and then passing a current of electricity through the solution to a metallic cathode.

Lamps and Appurtenances:—

LIGHT RETRACTING AND MAGNIFYING ENVELOPE FOR INCANDESCENT LAMPS. F. W. Dunlap and J. R. Quainm, London, Eng., 597,964. Filed June 2, 1897. Comprises a light refracting envelope formed of a closely wound spiral of glass rod of circular or other section applied upon the bulb of the lamp.

Measurement:—

ELECTRIC METER. G. Kapp, Berlin, Germany, 597,985. Filed Nov. 19, 1897. Comprises a supplemental apparatus for permitting the consumption of energy to be metered or charged for at different rates for different hours of the day, and means for throwing the same into and out of operation.

Miscellaneous:—

TARGET. T. Wrench, Metuchen, N. J., 597,795. Filed March 15, 1897. Operates to instantly indicate the score at any desired point away from the target proper.

ARMATURE WINDING MACHINE. C. Eickemeyer, Yonkers, N. Y., 597,816. Filed October 30, 1897. Combines with four coiling plates, and screws for actuating them, a gauge plate appropriately inscribed according to the various coils desired and traversed by a pointer carried by one of the plates.

ELECTRIC FURNACE. W. S. Horry, Sault Ste Marie, Mich., 597,880. Filed April 16, 1897. Comprises a bottomless hopper, electrodes supported on its walls, circuit connections for the electrodes, a rotatable receptacle arranged below the hopper, and plates removably applied to the periphery of the receptacle.

ELECTRICALLY ACTUATED LOCK FOR BICYCLE RACKS. F. V. Walstrom and J. Erickson, Chicago, Ill., 597,891. Filed November 9, 1896. Comprises a locking mechanism, an alarm mechanism, a relay arranged to control the alarm mechanism, and a normally closed electric circuit arranged to control the relay.

ELECTRIC FURNACE. C. S. Bradley, Avon, N. Y., 597,945. Filed December 13, 1896. Comprises a rotary annulus carrying on its periphery a receptacle for a charge, the receptacle having sectional walls permitting it to be opened and electric connections with the inside of the receptacle.

Railways and Appliances:—

ELECTRIC RAILWAY. E. C. Crocker, Bridgeport, Conn., 597,799. Filed April 23, 1897. Third rail system.

TROLLEY. G. A. Hall, Portland, Me., 597,848. Filed February 6, 1897. The roller stock is pivotally supported on the head of the pole.

SYSTEM OF ELECTRIC DISTRIBUTION. H. Linton, Altoona, Pa., 597,855. Filed May 7, 1894. Sectional underground system for railways.

RAIL CONNECTOR. J. Bryan, Pittsburg, Pa., 597,949. Filed June 12, 1897. Comprises a series of metal plates arranged approximately parallel with the rail, but separated from each other, and metal blocks adapted to be secured to the rails, a portion of the metal of the blocks intercalating with the metal plates.

Roentgen Rays:—

APPARATUS FOR MAKING OBSERVATIONS BY MEANS OF ROENTGEN OR X-RAYS. J. Wertheimer, Paris, France, 597,753. Filed July 27, 1897. Comprises two vertical casings between which the object to be examined is placed, one casing containing a vacuum-bulb, and the other a fluorescent screen.

Switches, Cut-Outs, Etc:—

SAFETY FUSE. L. A. Ferguson, Evanston, Ill., 597,969. Filed May 24, 1897. A fuse having broad ends to engage the conductor terminals, the ends being connected by an arch, a small portion of the length of which is contracted to constitute the point at which the rupture of the fuse will occur.

ELECTRIC SWITCH. J. L. Hinds, Syracuse, N. Y., 597,979. Filed February 1, 1896. Comprises a base to which the switch terminals are secured, a blade for closing the circuit between the terminals, and a backing of a slotted tube to which the blade is removably secured.

ELECTRIC SWITCH. J. R. Newell, Titusville, Pa., 597,001. Filed September 15, 1897. Push button switch. Details of construction.

Telegraphs:—

TELEPHONIC INSTALLATION. G. Ritter, Stuttgart, Germany, 597,782. Filed June 11, 1896. Multiple switchboard system for telephone exchanges.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 597,785. Filed April 16, 1895. A relay in the line circuit controls a subsidiary signal in a local circuit.

TELEPHONE CIRCUIT. C. E. Scribner, Chicago, Ill., 597,786. Filed December 18, 1896. Means for supplying current for transmitting telephones at sub-stations from a centrally located source of energy.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 597,787. Filed December 18, 1896. Means for automatically controlling line signals through the agency of the station apparatus of the line and for causing the effacement of the signal in the establishment of the required connection.

Construction Work at the Exhibition.

It was announced last week that the post of Consulting Engineer to the Electrical Exhibition had been accepted by Prof. F. B. Crocker, of the Department of Electrical Engineering, at Columbia University. We are now glad to note that the position of Construction Engineer has been assigned by the management to Max Osterberg, E. E., A. M., of the engineering firm of Osterberg & Sutton. This gentleman has already taken up his new duties in consultation with Prof. Crocker, and is preparing plans, etc., for the elaborate wiring, distribution and general construction required by so large a show as that for next May has already become. Mr. Osterberg made a distinct success by his work at the Exhibition of 1896, and now takes hold with greater energy and enthusiasm than ever.

A Personal Exhibit By Prof. S. H. Short.

In addition to the superb exhibit which will be made of all its modern apparatus for the generation and use of electricity, by the Walker Company, of Cleveland, Prof. S. H. Short, its electrical engineer, well known as one of the most distinguished and successful pioneers in the electric railway field, will make a personal exhibit. For some 15 years past, Prof. Short has been actively engaged in railway design and invention, and as far back as 1885 organized a company in Denver which laid and operated a slotted conduit railway. His work will now be interestingly and richly illustrated by pictures, relics, models, old apparatus, etc., and will constitute one of the features of the show that will attract wide attention and help secure for Prof. Short, the recognition which certainly is his due.

Law Against Theft of Current in Georgia.

WE give below full text of a bill for the protection of electric lighting companies, which has just been passed by the General Assembly of Georgia:

A Bill to be entitled, An Act to protect Companies engaged in the manufacture of electricity in this State for lighting or power purposes, in the use of apparatus employed in generating, transmitting, measuring or using the same, to prevent persons from unlawfully diverting and using such electric current, to prescribe a penalty for the violation of the provisions of said Act, and for other purposes.

Section 1. Be it enacted by the General Assembly of the State of Georgia, and it is hereby enacted by the same, that whoever unlawfully and intentionally injures or destroys or permits to be injured or destroyed, any meter, pipe, conduit, wire, line, post, lamp, or other apparatus belonging to a company engaged in the manufacture or sale of electricity for light-

ing or power purposes, or unlawfully and intentionally prevents an electric current from fully registering the quantity of electricity supplied, or in any way interferes with its proper action or just registration, or, without the consent of such company unlawfully and intentionally diverts any electric current from any wire of such company, or otherwise unlawfully and intentionally uses or causes to be used without the consent of such company, any electricity manufactured or distributed by such company, shall, for every such offense be punished by a fine not exceeding $100 or imprisonment not exceeding one year, or by both such fine and imprisonment.

Section 2. Be it further enacted, that all laws and parts of laws in conflict with this Act be and the same are hereby repealed.

Decision of the U. S. Circuit Court for the Southern Div. N. Y. Sustaining the Van Depoele Trolley Patent.

United States Circuit Court, Southern District of New York. Thomson-Houston Electric Company vs. Union Railway Company.

Motion for preliminary injunction under claims 2 and 4 of the Van Depoele patent No. 495,443. Lacombe, Circuit Judge.

The circumstance that these two claims were not expressly declared upon, in the Winchester avenue case divided by Judge Townsend (71 F. R. 192) is not controlling. In Westinghouse Air Brake Company vs. N. Y. Air Brake Company, 65 F. R. a preliminary injunction was granted by this court on patent No. 360,070, although it had not been previously adjudicated, on the ground that in the earlier litigation it had been "discussed at great length and its meritoriousness clearly recognized." And that injunction was sustained in the Court of Appeals (69 F. R. 715).

It is perfectly plain from an examination of the opinion of Judge Townsend and the voluminous record upon which it was based that the very combination covered by claims 2 and 4, viz., the overhead conductor and the trailing arm hinged and pivoted to the car so as to bridge the space between it and the conductor, with a contact device at its upper end, capable of being pressed upwardly into engagement with the conductor, was fully considered by him and held to be a most meritorious invention, and Van Depoele its inventor. It is thought that the decision of the Court of Appeals in this Circuit in the Hoosick Railway Case (82 F. R. 461) has not affected the weight of the Winchester avenue decision so far as it deals with the questions of invention and priority. The Court of Appeals held that claims 6, 7, 8, 12 and 16 of the patent here sued on were invalid because the particular combination or combinations which those claims covered had been already patented by Van Depoele in his earlier patent No. 424,695. And this was all that it held. The complainant therefore comes into this court with the presumption arising from those judicial conclusions in the Winchester avenue case, which the Court of Appeals did not disturb.

The two claims now declared on are as follows:

"2. The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor and an arm carried by the car and carrying the contact device, and pivoted so as to swing freely around a vertical axis."

"4. The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor, and an arm on the car movable on both a vertical and a transverse axis and carrying the contact device."

In the Hoosick Railway Case double patenting was found, because each of the claims therein considered contained in some form of words a reference to a "spring" or "weight" or "weighted spring" or "torsion spring" or "spring device," one of whose two functions was to centralize the depressed end of the trolley, and the other was to give the upward pressure to the contact end.

The two claims above quoted contain no words which can be tortured into any such reference. Manifestly they were intended to cover and do cover only the combination of the car and conductor, with an underrunning trolley capable of swinging freely on a vertical axis, and thus adapted to curves and irregularities in the conductor. And Judge Townsend held that Van Depoele was the first to make practicable the electrical propulsion of an electric railway by "a long rigid arm upwardly pressed and capable of universal movement." The defendant contends that the weighted spring, which is the only means for imparting upward pressure disclosed in the patent, must be read into these claims, for the reason that without it the claims would cover "inoperative and useless" combinations. It seems unnecessary to discuss the authorities cited by complainant in opposition to this contention (Deering vs. Winona Harvester Co., 155 U. S. 286, Taylor vs. Sawyer, 75 F. R. 301, Halloway vs. Dow, 54 F. R. 511). Although an additional device may have to be added to make the combination operative automatically, it is none the less operative without such addition. A boy seated on the roof of the car could impart the upward pressure, not as economically, nor as well as the weighted spring would, but quite sufficiently to insure the operation of the combination expressed in the claim.

It must be concluded then that claims 2 and 4 do not cover a spring or weight or torsion device, and it is conceded that they contain no switching device. In the earlier patent no claim is to be found, which does not contain either the spring or weight, or the switching device. It would seem then that these claims certainly are not obnoxious to the criticism of the Court of Appeals and that no "double patenting" is shown. And since the meritoriousness of the invention, and Van Depoele's priority was found by Judge Townsend in the Winchester avenue case, complainant should be entitled to hold what it has established after long and expensive litigation unless the case presented here is changed by evidence not before the court in that case. I cannot see that the Hunter and Deligny patents, which are the only new ones, are any more of an anticipation than were those introduced in the Winchester avenue case.

It is further contended that complainant has unreasonably neglected and delayed to enter a disclaimer of claims 6, 7, 8, 12 and 16 of the patent in suit, which were held void by the Court of Appeals. That decision, however, was rendered upon an appeal from an order, and complainant is naturally averse to finally relinquishing these claims, until it may have had an opportunity to apply to the Supreme Court for a certiorari, an application which it is useless for it to make, when only a preliminary order is involved. There seems to be good ground for delaying disclaimer.

The argument that by its disclaimer of claim 9, complainant has disclaimed the entire invention of the patent, which is therefore wholly void, is unfortified by authority and unpersuasive.

Infringement cannot be seriously disputed. Defendant's device is practically a duplication of that used by Van Depoele in New Orleans in 1885. Complainant may take order for injunction pendente lite, but when issued its operation may be stayed for thirty days to give defendant an opportunity to review this decision at this term of the Court of Appeals.

Feb. 7, 1898.

The Walker Company state that this decision will be appealed and vigorously contested.

THE STOCK MARKET

Trade and Commerce Growing.

While the recent severe winter weather has checked the distribution of goods a little, it has bettered some lines very materially, such as coal, heavy wear, etc. The demand for iron and steel is very active. Railway earnings are again good, business failures are small, bank clearings are larger and the money market is very easy. Stocks and bonds have been brisk and firm at higher figures in spite of reactions.

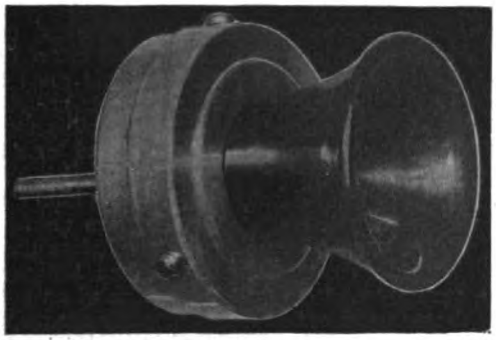
During the week 23,399 shares of Western Union were sold up to 92⅝. There was a marked advance in General Electric, 33,143 shares exchanging hands at prices that rose from 36½ to 39½, there being reports of large business and of financing plans to fund back dividends still unpaid. In Boston, Bell Telephone was strong, but dull, owing to the great storm which interfered with business generally. New York Edison's annual report is regarded as a great bull document. The stock is up to 133½ and there are rumors also of a stock dividend.

Copper is quoted at 11 cents, rising; steel rails are unchanged at $18.

TRADE NOTES & NOVELTIES

Logansport Coal Grain Microphones.

THE coal grain microphone transmitter manufactured by the Logansport Telephone Manufacturing Company, Logansport, Ind., can be placed on any telephone and will add to its appearance and efficiency. Only the very best of material is used in its construction. It is fully guaranteed not to pack. It is said to be an impossibility for it to get any moisture from the breath or atmosphere. Any transmitter that will absorb

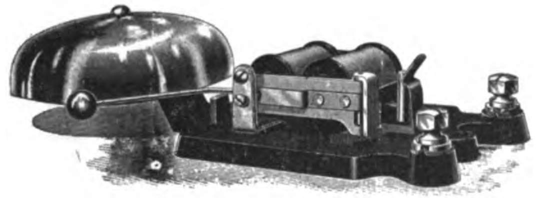


LOGANSPORT COAL GRAIN MICROPHONE TRANSMITTER.

moisture will pack. It gives a clear, distinct enunciation, and does away with harsh metallic rasping, scraping and squealing noises. It has volume for long lines; will work over any length line, either grounded or metallic, and gives the very best of satisfaction. It costs but a dollar, and is made by the Logansport Telephone Manufacturing Company, Logansport, Ind.

The Marlo Iron Box Bell.

The Proctor-Raymond Manufacturing Company, 444 Niagara street, Buffalo, N. Y., are receiving large orders for their new iron box bell called the "Marlo." This bell embodies many admirable features among which the following may be mentioned: A contact post which cannot loosen or change its position on the base, an armature which is brought very close to the core without touching it, thus utilizing the full power of the magnets, (the Marlo armature never sticks) a double adjustment of the con-



THE MARLO IRON BOX BELL.

tact and adjusting spring, made of one piece of phosphor-bronze, a gong which cannot turn or loosen, a hammer rod which will always retain its shape, and a cast-iron cover neatly japanned inside and out. The best material is used, the workmanship is first-class and each bell is in perfect adjustment for one or two cells.

Electric Elevator Wanted.

The Treasury Department, Washington, D. C., through the office of the Supervising Architect, is advertising until 2 o'clock p. m., February 16, 1898, for bids for all the labor and materials required for an electric elevator for the United States Courthouse and Postoffice Building at Little Rock, Ark. All communications and proposals should be addressed to the Supervising Architect at Washington, D. C.

STERLING ELECTRIC COMPANY, of Chicago, has been formed, with a capital stock of $30,000, to make apparatus. The incorporators are E. A. Biggs, John E. Hunt and W. I. Hall.

Oberg & Blumberg.

IN our issue of December 23, 1897, we referred to the Alexander-Chamberlain Electric Co., one of the most successful concerns in the field of electrical engineering and contracting in New York, and we now take pleasure in announcing the formation of a new concern, the offspring of this company, consisting of Messrs. J. L. Oberg and M. S. Blumberg.

Messrs. Oberg & Blumberg have opened offices at 853 Broadway, corner 14th street, with full facilities for executing contracts for electrical work of every description. Both members of this new and promising firm are well known to the electrical profession and have had a varied and extensive experience in the electrical business.

Mr. J. L. Oberg has been in the electrical field for the past thirteen years. Five years at the Thomson-Houston factory at Lynn; two years for the Thomson-Houston Company in New York, in charge of construction; two years for the Tucker Electrical Construction Company, in charge of construction; four years with the Alexander-Chamberlain Electric Company, as superintendent and in charge of construction.

Mr. M. S. Blumberg has been in the field for the past seven years, one year in the factory of the Zucker-Levett Chemical Company, manufacturing dynamos and motors, and for six years with the Alexander-Chamberlain Electric Company, in every capacity.

The firm starts out in business with the best wishes of a host of friends and if they are true to their motto that "The only way to procure success, is to make it," they are sure to procure a good share of it for themselves.

German Branch of the Garvin Machine Co.

The Garvin Machine Company, New York, have opened a branch house in Berlin, Germany, at 17 Burgstrasse, where they intend carrying a full line of their own tools and American machinery. This is an excellent move, and the Garvin Machine Company will practically be the first firm carrying a full line of their goods in stock in Germany. Judging from the demand for American machinery abroad, there is very little doubt that the Garvin Machine Company will do a successful business there. Several large shipments have already been made for stocking the branch and these will continue from time to time as the demands require.

Edwards & Co.'s Bells for High Potential Circuits.

Edwards & Co., 144th street and 4th avenue, New York, are manufacturing all styles of bells to operate on 110 and 500-volt circuits. Their construction is very simple and they have proved very successful wherever used. The cost is very little more than the ordinary bell. We are informed that Messrs. Edwards & Co. are at present the only manufacturers of bells which operate direct on high potential circuits.

Nearly 3000 Testimonials To Magnolia.

The Magnolia Metal Company during the last three or four months has received through the mails nearly 3,000 testimonials on Magnolia Metal, or to be exact, they received 2,827 distinct testimonials. These testimonials were received from every part of the United States and Canada, and were sent in by railway companies, steamship companies, rolling mills, iron and steel manufacturers of every kind and description, machinists, paper mills, cotton mills, woolen mills, wood-working establishments of all kinds, and practically every class of mechanical industry that can be mentioned.

These testimonials came to them in response to a circular letter sent out to all the mills and manufacturers of the United States and Canada, accompanied by a 15-inch rule sent with their compliments, and simply asking if they were users of Magnolia Metal, and, if so, what was their experience.

A very small percentage of concerns so addressed ever make response, and taking the number of replies actually received, giving testimony as to the superiority of Magnolia Metal, it has been estimated that at least 100,000 concerns in the United States and Canada are to-day using Magnolia Metal.

The above statement is a very remarkable one and shows the wonderful success that the Magnolia Metal Company has had during the past 10 or 12 years in introducing their metal among the mills, electrical plants, manufacturers, jobbers and dealers

of the United States and Canada; and their trade is equally as large in foreign countries. This shows what can be accomplished by having a good article well exploited and thoroughly advertised.

A Laboratory Lakon Transformer.

The Lakon Company, of Elkhart, Ind., received recently the following letter from Mr. W. H. Merrill, the electrician of the Chicago bureau of the National Board of Fire Underwriters:

"I have your favor of September 11, making inquiry concerning the 5-kilowatt transformer giving differences of potential as high as 40,000 volts which we purchased from you last spring.

"We have used this appliance continuously in our experimental work since its installation and the results obtained have been in every way satisfactory. It is to-day an indispensable feature of our laboratory equipment."

The Adams-Bagnall Electric Co.'s 1898 Souvenirs.

Manager C. W. Phipps, of the Eastern office of the Adams-Bagnall Electric Company, Cleveland, O., is sending out beautiful penwipers, consisting of red, white and blue cloth, surmounted by a large white button, to his many friends in the trade, who thoroughly appreciate this useful souvenir.

The Somerset, Ky., Lighting Contract.

The city of Somerset, Ky., has awarded the contract of furnishing lights to the city and its citizens to Mr. Beecher Smith, proprietor of the Somerset Ice Company. He will begin the construction of a plant about April 1, having a capacity of 1,000 16 candle power incandescent lamps, 100 40 candle power incandescent lamps for street circuits and 25 1,200 candle power arc lights for street circuits. There is a stipulation in the contract between Mr. Smith and the city that a duplicate plant is to be provided.

Removal of the Crouse-Hinds Electric Co.

On or about Feb. 15, Mr. F. W. Hawkins, Eastern agent for the Crouse-Hinds Electric Company and Pass & Seymour, will occupy the store 23 Dey street, Havemeyer Building, where he will continue the sale of the standard apparatus of the above companies.

H. C. Roberts Electric Supply Co.

The H. C. Roberts Electric Supply Company have opened a store at 831 Arch street, Philadelphia, Pa., occupying the first floor and basement, each 25 x 137 feet, extending back to the rear street, and have it well filled with a full line of electrical supplies of every description from the leading manufacturers of the country. Among the companies whose product they control in this section are the Bryant Electric Company, the Clifton Manufacturing Company, the D. & W. Fuse Company, the Gibbs Electric Manufacturing Company and A. O. Schoonmaker. Mr. Roberts is a thoroughly competent man, having had over thirteen years practical experience in the manufacturing and selling of electrical apparatus, starting in with the Schuyler Electric Company when in Hartford, afterwards accepting a position as foreman of the winding department for the Mather Electric Company, the Eddy Electric Motor Company and the Connecticut Motor Company. He also spent some time as traveling salesman for the latter. While in Hartford, Mr. Roberts purchased the Hartford Electric Time Company, which he afterwards sold to a stock company.

During the past seven years Mr. Roberts has been identified with the electrical supply business in Philadelphia and has a large circle of friends.

At the formation of the Electrical Trades Association Mr. Roberts was elected a member of the executive committee, which position he held until severing his connection with his former firm. Mr. Roberts starts in at an excellent time, under most encouraging auspices and with an already established trade.

PATTERSON, GOTTFRIED & HUNTER, 146 Centre street, New York, are agents for McClelland's oil purifier.

Queen & Co.'s New Cell Tester.

THE accompanying cut illustrates a new instrument placed on the market by Queen & Company, of Philadelphia, to meet the demand for a low-priced, accurate cell tester.

The Queen cell tester is sensitive and accurate, and the pointer dead-beat. The extreme uniformity of the scale permits of reading with accuracy from 0 to the maximum value for which the instrument is calibrated. The pointer always swings toward the positive pole and may therefore be used as a polarity indicator.

As the instrument is but 3½ inches in diameter and 1⅝ inches in depth, it may easily be carried in the coat pocket. The simplicity and careful construction of the meter render it proof against injury during transportation.

The accompanying flexible leads obviate the necessity and annoiance of hunting up stray pieces of wire for connectors.

A convenient range is from 0 to 10 volts, this permitting of testing several primary or storage cells either singly or in series.

The Queen cell tester is particularly recommended to those having the care of X-ray apparatus, or others having charge of instruments employing storage cells.

ADVERTISERS' HINTS

THE WESTERN ELECTRIC COMPANY, Chicago and New York, advertise "swinging tree" insulators for the protection of lines from swaying branches without cutting the insulation.

MACHADO & ROLLER, 203 Broadway, New York, wish it understood that they are in the lamp business to stay; that they are carrying a larger stock than ever, and that they are looking for competitive tests.

THE ELECTRIC STORAGE BATTERY COMPANY have removed their San Francisco office to 10 Front street, where their facilities are greater for handling their business in that city.

W. R. BRIXEY, 203 Broadway, New York, is now represented also by the Buffalo Engine Works, Buffalo, New York.

I. P. FRINK, 551 Pearl street, New York, states that his patent reflectors and reflecting chandeliers have lighted over twenty thousand churches alone.

THE McCAY-HOWARD ENG. COMPANY, 106 East German street, Baltimore, Md., say that by means of the Ries sockets, incandescent lamps may be operated as easily as gas.

THE WALKER COMPANY, Cleveland, O., illustrate their 50 kilowatt direct-connected steel generator and refer to the Waldorf-Astora as a model isolated plant of the Walker type.

F. E. BAILEY & COMPANY, 913 Betz Building, Philadelphia, Pa., are now the agents for the Armington & Sims Company, Providence, R. I.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, advertise Noxall annunciators.

TYREE & WILKINS, Lynchburg, Va., may be addressed for information regarding an opportunity to invest in a well equipped lighting, power and railway plant, which is to be sold under foreclosure on Feb. 28.

THE EVENING POST, of New York, advertises Mr. G. H. Guy's brilliant article on the Decade of Electric Railway Work, dating from the Sprague road at Richmond, Va.

NEW YORK NOTES.

THE WARD LEONARD ELECTRIC COMPANY report a surprising increase in the demand for their circuit breakers since January 1. The 100 ampere size seems to be the size most frequently required. The Ward Leonard Company has been obliged to increase its force in the line of circuit breakers several times in the last few months, and if the demand continues to in-

crease, will have to erect a third building, as their present two buildings are fully occupied.

THE BURGE-LEWIS ELECTRIC PROTECTIVE COMPANY, of New York City, has been formed. Capital, $50,000, and directors: H. I. Burge, of 110 East 109th street; M. H. Lewis, Simon Schwartz and Joseph Schwartz, of New York City.

ARC LAMPS manufactured and shipped from the factories of the General Electric Company within the past fiscal year, have exceeded 24,000. Many thousands of the enclosed arcs are now in service and the introduction of the alternating enclosed lamp has still further increased the sales.

THE AMERICAN COFFEE COMPANY, of Brooklyn, N. Y., are erecting a new power house in connection with their plant, which is about 70 feet wide and 120 feet long. The power house and boiler house have brick side wall construction and steel supports and roofing. Adjoining the boiler house is a coal bunker about 20 feet wide, which carries the supply of coal in a steel bin about 30 feet above the ground. The whole plant has been designed with convenience and economy in view, and can be very economically operated. The contract for furnishing and erecting the steel framework of the building has been let to the Berlin Iron Bridge Company.

THE E. G. BERNARD COMPANY, of Troy, has sent out to its friends a very neat and handsome thermometer mounted on a large decorative card. It is highly appreciated.

W. F. HARING, 609 Havemeyer Building, is the New York agent for Armington & Sims' engines, Providence, R. I.

OSTERBERG & SUTTON, consulting engineers, 11 Broadway, apparently have felt the drift of the better times. Among the plants in their office at present are the Harmonie Club in West Forty-second street and the Cushman Building, corner of Broadway and Maiden Lane, which are nearing completion, and amongst the new work which has come to their office since the beginning of this year are: The handkerchief factory of James F. White & Co. and two other factories for which they are now preparing plans; the lighting, heating and ventilating part for Smith College, a new theatre in the course of construction on the Boulevard; the Puritan Church in Brooklyn; the residences of Mr. Marks Arnheim in Long Branch, several private dwellings in Ridgewood, N. J., and the elegant private residences of Mr. Isaac D. Fletcher, corner of Seventy-ninth street and Fifth avenue and of Mrs. Jessie Converse, 5 East Seventy-eighth street.

NEW ENGLAND NOTES

G. M. ANGIER & CO., of 64 Federal street, Boston, have taken the entire selling agency of the Paragon arc lamps, previously sold by the Paragon Arc Lamp Company, of Boston. These lamps have already achieved for themselves a good reputation, and will hereafter be made open or enclosed and for all circuits. Messrs. G. M. Angier & Co. have long been favorably known to the New England trade, having represented the Eddy Electric Manufacturing Company for years in Boston, where they have done a most successful business. Mr. George Angier, the head of the concern, is particularly well known and enjoys a well deserved popularity, not only in New England, but throughout the whole country, as he has all his life been identified with electrical interests. In his hands therefore the Paragon arc lamp is bound to become a success, and with the many new styles of lamp which he intends bringing out in the near future, we expect to hear of Mr. Angier doing a large and successful business.

MR. H. C. THOMSON, of the Electric Gas Lighting Company, 195 Devonshire street, Boston, was elected manager at the annual meeting of the company.

THE NATIONAL ELECTRIC COMPANY, of Bridgeport, Conn., have contracted to make 700 clocks to control the lighting and extinction of gas jets at certain predetermined hours.

THE ANCHOR ELECTRIC COMPANY, by its treasurer, Mr. Norman Marshall, has brought suit for $25,000 damages against its retiring president, H. C. Hawks, for breach of contract and interference with its business and employés. An injunction was granted by Judge Holmes, of the Supreme Judicial Court, on Feb. 2, restraining Mr. Hawks from further interference with the business and employés of the Anchor Electric Company.

THE BERNSTEIN ELECTRIC COMPANY, which on the 20th inst. made an assignment, is in the hands of Gen. B. F. Peach, Jr., of Boston. It is his intention to continue the business and fill orders as promptly as possible.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., have received license from the General Electric Company to manufacture their Edison base specialties. This bids fair to grow into a large department of the Bryant Electric Company.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. FEBRUARY 17, 1898. No. 511.

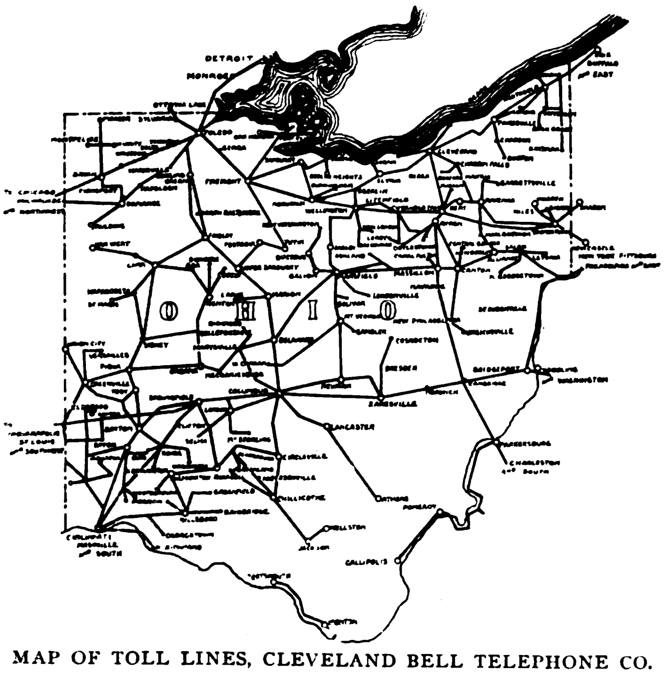
TELEPHONY AND TELEGRAPHY

The New Exchange of the Cleveland Telephone Co.


The Cleveland Telephone Co.'s Building.

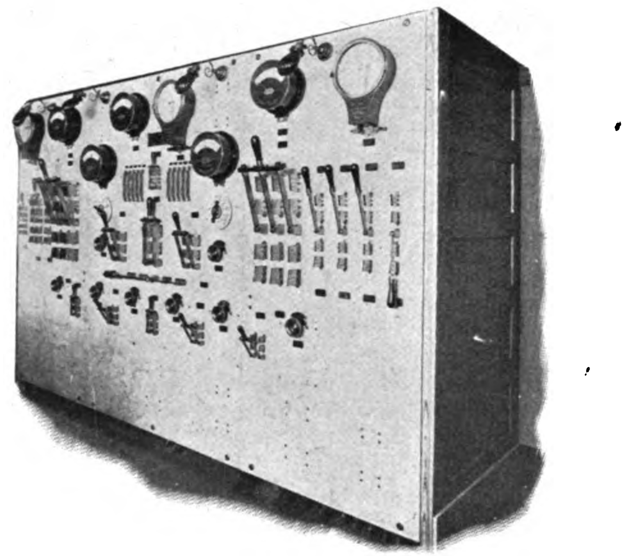
SOME three years ago the Cleveland Telephone Company began work on a new building to accommodate its offices and its main exchange, and about the same time contracts were let for the re-equipment of all its exchanges. The building was completed in eighteen months, but the exchange equipment was not ready for installation until the fall of 1897. The time between September and January last was occupied in connecting up the new switchboard for the main exchange, and at 2 a. m. of January 9, the transfer from the old exchange to the new was made. The month which has elapsed since then has given every opportunity to test the working of the exchange and system, so that now something may be said regarding the equipment and the present and probable future results.

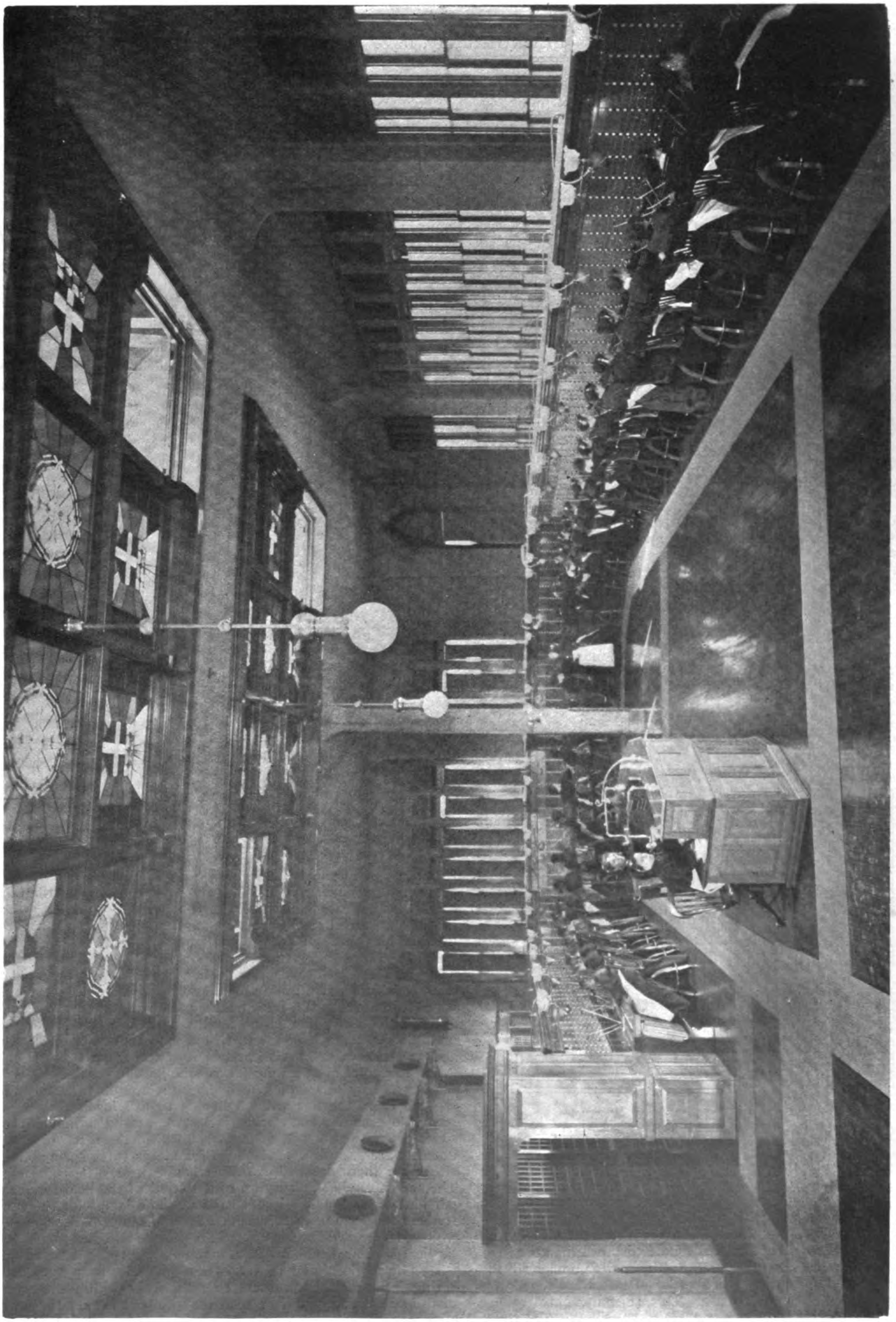
The Cleveland Telephone Company opened its first exchange in 1879, using what was known as the Scott system of switching. Later the Jones system was used, and this was followed soon after by the Western Electric standard switchboard. In 1889, the Western Electric Company installed a single-cord multiple switchboard for the company in its main exchange at an expense of $25,000. This board was built to accommodate 5,400 subscribers and was equipped at that time for 1,800 subscribers. Its equipment was subsequently increased to 2,800 subscribers, the board, with additions, representing an investment of about $50,000. Although only a little over eight years old, this switchboard became inadequate to the demands of the business, and it has now given way to the new equipment of the main exchange, the switchboard and apparatus in the latter costing something over $100,000. This re-equipment is along the line of policy of the Cleveland Telephone Company to keep abreast of the times, by availing itself of all modern improvements. Within the past few years the company has put in an extensive underground system, which now includes a total of 94,533 feet of conduit, containing 653,419 feet of duct. Within the city there are 7,370 miles of the company's wire underground, while the overhead plant consists of as much more. The overhead lines have been rebuilt throughout the city, and nearly, if not all the wires, are now copper. The company has five exchanges in the city—Main, East, West, Doan and Glen, with a total of over 5,000 subscribers. The re-equipment of the branch exchanges is progressing rapidly, and within a few weeks the entire system will be operated on a uniform plan. The work of re-equipment is in the hands of the Western Electric Company.


MAP OF TOLL LINES, CLEVELAND BELL TELEPHONE CO.

The main exchange switchboard, just completed, is set in a large, well-lighted and finely finished room, which is heated and ventilated by a blower system, the air being thoroughly sprayed and then dried and heated before being forced into the room.

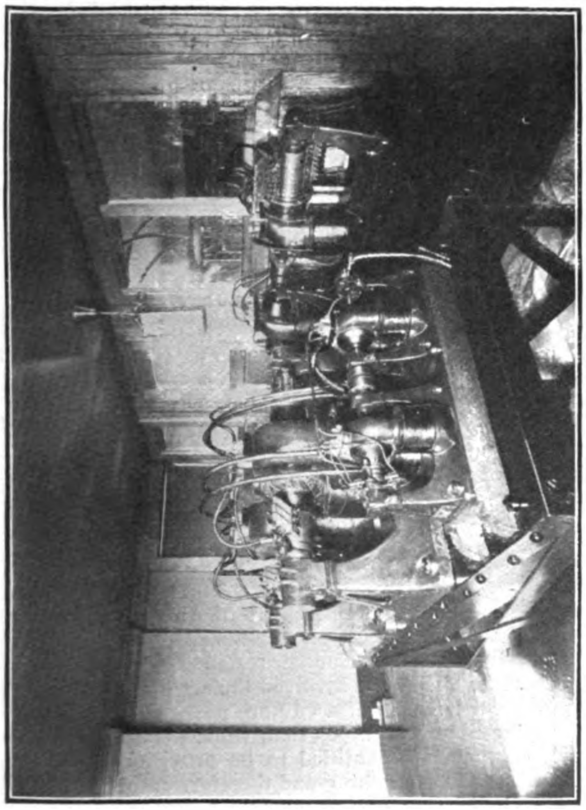
The switchboard itself is the latest work of the builders and has given entire satisfaction. It is divided into 25 sections, two operators to each section, and is designed to accommodate a total of 5,400 subscribers. At present its capacity is 3,600 subscribers. It is equipped throughout with a system of signalling by means of incandescent lights. The wires are brought into the building underground, and are arranged on distributing frames in the "terminal room" in the basement. After going through the arresters, both carbon and heat coil, they are carried up in cables through a large shaft to the sixth floor of the building, where they are arranged on the intermediate distributing board. This board, which is a system of iron racks similar to a regular distributing frame, makes provision to carry the wires to and from the relay racks and then to the answering and also to the calling jacks in the switchboard. Under the multiple system each line is carried around the entire exchange, and at periodical intervals is taken to a spring jack, every line going to a total of 25 calling jacks—one jack for each section of the board. By this arrangement any operator in the exchange can tap in on the line without having to call for it through a second operator. The spring jacks are arranged in compact strips of 20, so compact, in fact, that within the reach of every operator are 3,600 lines. Each jack contains three springs, and altogether there are within the exchange nearly 100,000 jacks. The accompanying illustration of a section of the board gives a fair idea of the details of construction. The lamps for the subscribers terminating in this section are indicated by the rows of white dots toward the bottom of the picture and just above the keyboard. The keyboard is aranged to meet the demands of party line service. The center of the picture shows the 3,600 spring jacks which represent the subscribers within the reach of the operator. It will be seen that while an operator only answers calls for the subscribers represented by the lamps in


POWER SWITCHBOARD, CLEVELAND TELEPHONE CO.

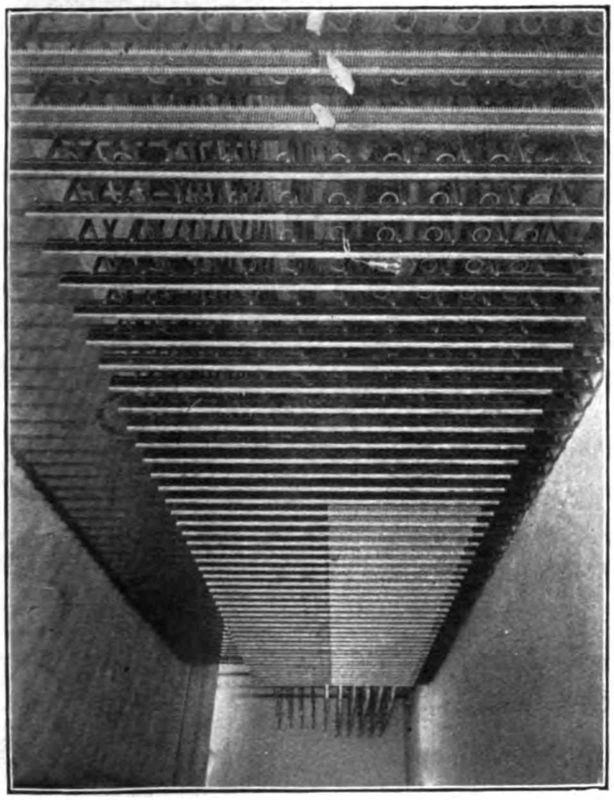


OPERATING ROOM, MAIN EXCHANGE, CLEVELAND TELEPHONE CO.

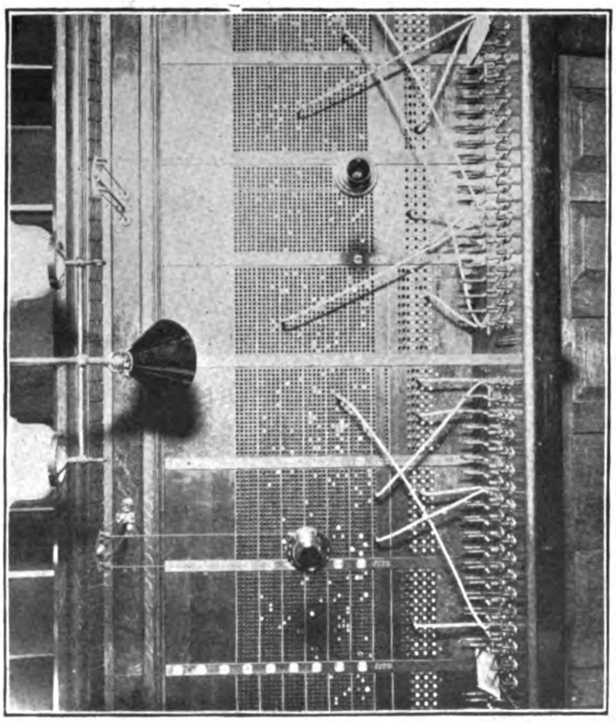
(Copyrighted.)



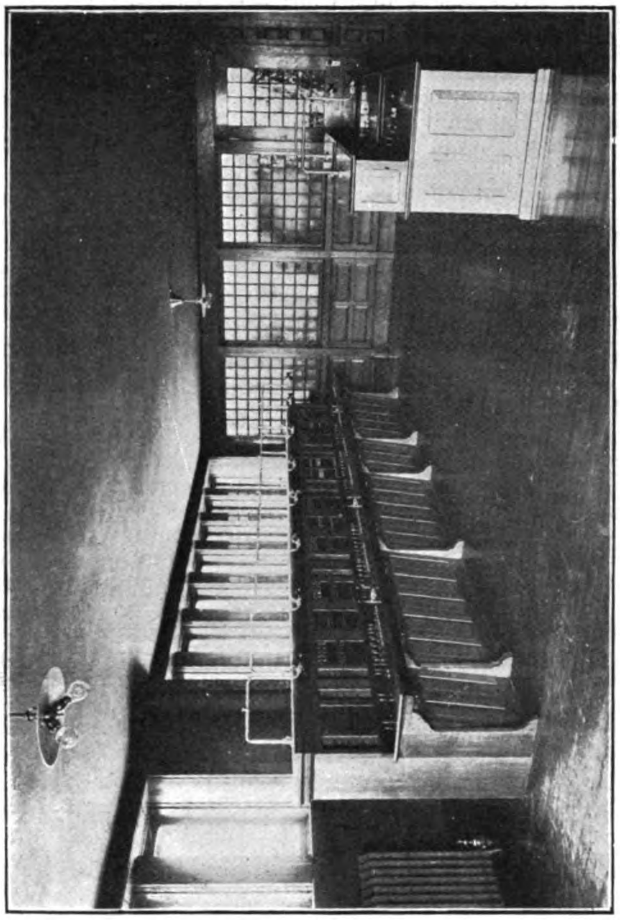
WESTERN ELECTRIC POWER PLANT, CLEVELAND TELEPHONE CO.



THE TERMINAL ROOM, CLEVELAND TELEPHONE CO.



SECTION OF LOCAL SWITCHBOARD, CLEVELAND TELEPHONE CO.

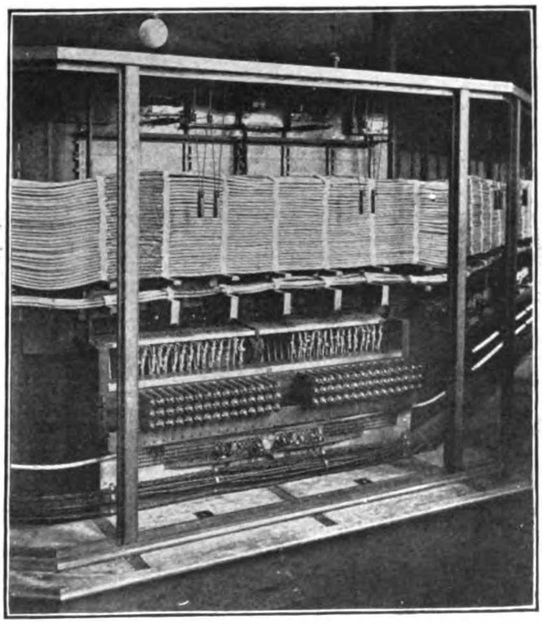


THE LONG DISTANCE ROOM, CLEVELAND TELEPHONE CO.

front of her, she has within her reach every line in the exchange, and facilities for reaching all branch exchange subscribers on trunk lines. When a subscriber takes his telephone off the hook, the lamp corresponding to his line flares up and the operator answers him with one of the small plugs shown in the picture. These plugs are on the ends of cords used for making connections. Connected with these cords are incandescent lamps which are used for disconnecting signals. When subscribers are through talking and hang up their telephones the disconnecting signal lamps light up, thus giving the operator automatic notice to disconnect.

A rear view of the switchboard, as shown in one of the accompanying cuts, gives one an idea of the complexity of wiring in the exchange. Each subscriber's line consists of three wires, two for the circuit, and one for an automatic test for the operator, to show when the line is in use. There are, therefore, exclusive of all trunk lines, 10,800 wires carried around the length of the board for the multiple system. The wires are placed in small cables which are tapped at regular intervals. The bunch of cables shown in the picture run around the switchboard and contain nearly 2,000,000 feet of wire. An idea of the detail of the exchange may be gained from the fact that in connecting the wires from these cables to the switchboard jacks over 300,000 soldered connections have been made. Adjoining the main exchange room is the "long distance" room, where all out-of-town connections are made and through which medium Cleveland subscribers can communicate with two-thirds of the people in the United States. In this room are "positions" for ten operators, with opportunity to double the size of the board.

Few people realize that a complete telephone plant involves a perfect power plant and equipment. In the power room are the two generators used for charging storage batteries, each two horse power; a three and one-half horse-power generator for lighting the signal lamps, two one-quarter horse-power generators for ringing, and forty-two cells of storage battery. The power



SECTION OF SWITCHBOARD, REAR VIEW, CLEVELAND TELEPHONE CO.

switchboard has, in addition to the regular switching apparatus, six ammeters, three of them recording, and two voltmeters.

The accompanying diagram shows the number of calls and the volume of business handled in the main exchange during the day. On certain days of the month each operator keeps tally, by means of pegs which she moves along the switchboard, of the number of calls she handles. At the end of every hour the totals are taken, and at the end of the day diagrams are made showing the number of calls handled in the exchange. The figures also show the total number of calls handled by each operator in the exchange, as well as the number of calls that each operator handles at any given time of the day. These figures are a basis for the transfer of wires to equalize the operating. A glance at the diagram shows that between 11 a. m. and noon there is a decrease of 2,000 calls per hour, so that apparently most Clevelanders go to lunch rather early.

The officers of the company are highly pleased with the working of the new switchboard. The expenditure of nearly $200,000 in the re-equipment of the company's exchanges is, of course, with a view toward improving the service and placing it in the

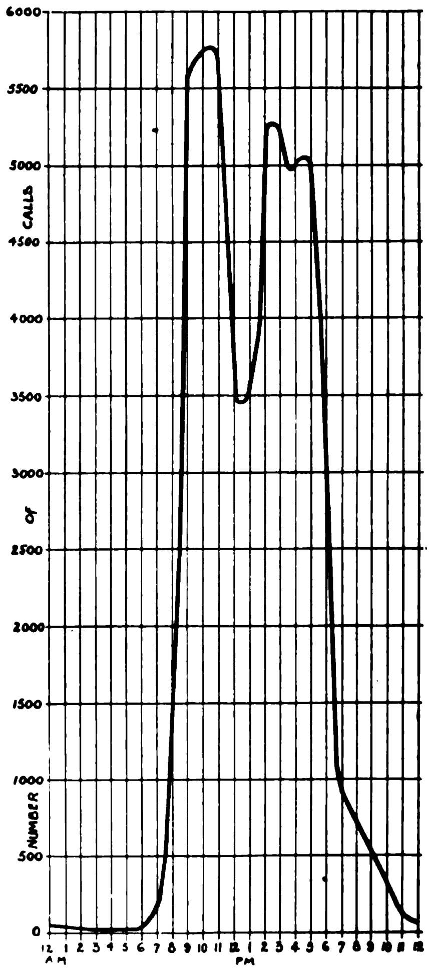


DIAGRAM OF DAY'S BUSINESS, CLEVELAND TELEPHONE CO.

front rank in the exchange service of the country. The change in the main exchange has already given gratifying results, and when the branches are uniformly equipped all subscribers will feel the benefit of the change.

The Cleveland Telephone Company is officered as follows: President, Levi Sprague; Vice-President, Chas. J. Glidden; Treasurer, Chas. A. Grant; Secretary, Geo. B. Perham; Directors, Levi Sprague, Chas. J. Glidden, Chas. E. Adams, W. J. McKinnie, Col. Wm. Edwards, E. P. Williams, Geo. W. Short, John E. Hudson, Gen. Thomas Sherwin, A. B. Hough and J. P. McKinstry. Mr. J. P. McKinstry is general manager; P. Yensen, superintendent, and C. T. McKinstry, manager.

Telephone Rights in Richmond, Va.

In the United States Circuit Court of Appeals Judge Simonton on Feb. 1 handed down an opinion in the case of the city of Richmond against the Southern Bell Telephone and Telegraph Company. The case involved the act of Congress of 1866 declaring that the streets of a city are post-roads of the United States. Judge Simonton holds that, while the act specifies only telegraph companies as entitled to its provisions, a telephone is to all intents the same thing and therefore entitled to its privileges. The Bell Telephone Company's charter having expired, the city exercised its stipulated right to revoke it, but was enjoined from interfering with the company's poles and wires. The effect of the decision is to modify the injunction so as to prevent the city from driving the the company from its streets, but the city is to retain its police power over it.

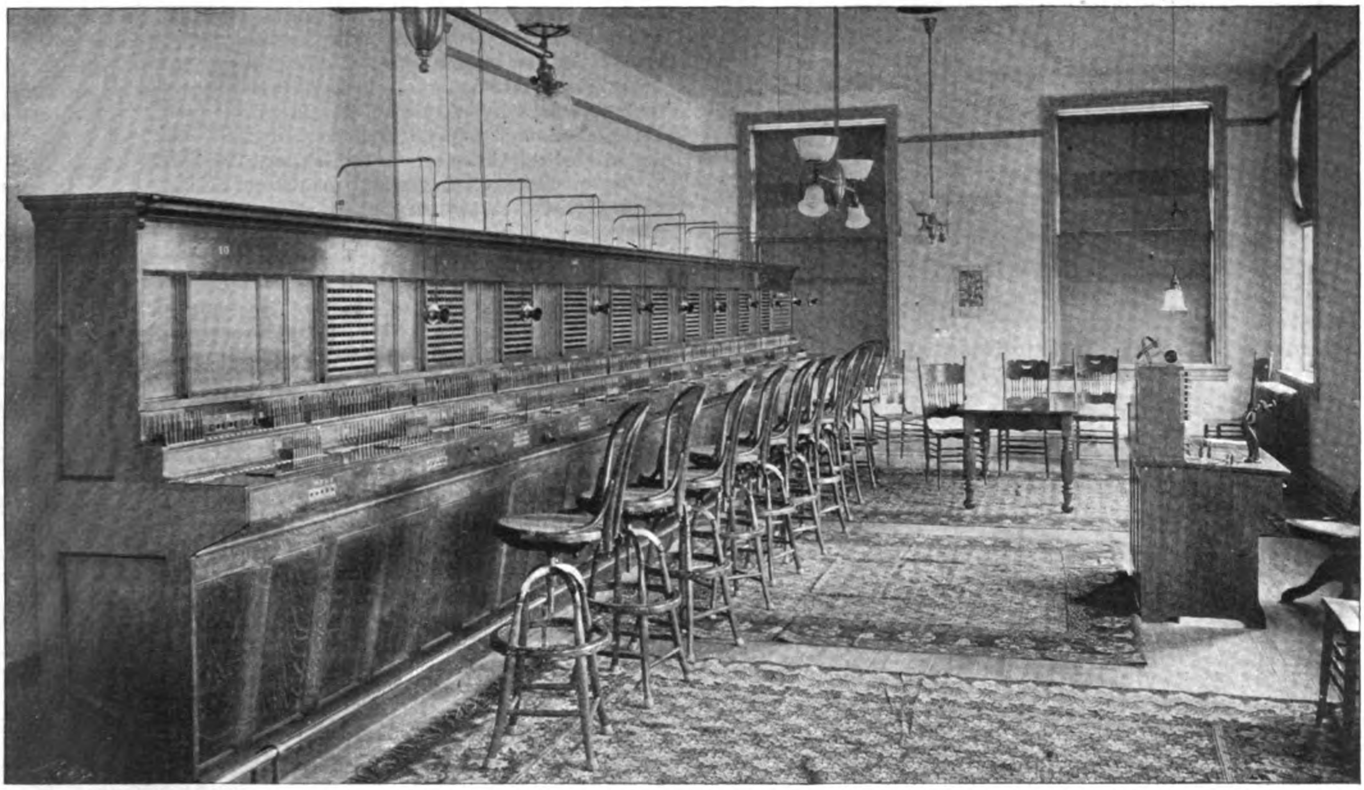
The Delmarvia Telephone Co.'s Exchange, Wilmington, Delaware.

ONE of the largest and most successful of the Eastern independent telephone exchanges is that of the Delmarvia Telephone Company, of Wilmington, Del. The company's exchange is at the corner of Seventh and Orange streets, in the heart of the business portion of the city of Wilmington. The Exchange Building, shown in the figure, is a substantial and handsome structure, specially designed for the telephone business. The second and third stories of the building are occupied by the company for the business of the exchange. The offices of the company are in the second story front apartments on this floor, and in the rear of the offices is the cross-connecting room. In this room is the cross-connecting board, which is a departure from the plans of all other boards in use. Owing to its peculiar construction it greatly facilitates the connection of the subscribers' telephones from outside lines with the switchboard proper.

The switchboard is already wired for 1,500 subscribers. A Crocker-Wheeler motor-dynamo is used for ringing, charging the storage batteries and for light and talking purposes. Power generators are also provided for the possible failure of the electric current received from the outside. These generators are attached to a water motor and can be turned on at a moment's notice. This makes the system practically independent of the outside supply of electric current. The switchboard is amply protected against lightning or excess of current by lightning arresters and fuses.

The switchboard is unlike others, and the entire system is extremely rapid and easy of manipulation. When a subscriber rings at his telephone, the drop or shutter on the switchboard representing his telephone falls before the operator, and at the same time a white light appears which attracts attention, and can only be extinguished by replacing the drop. This is done by placing the answering plug in the "spring jack," representing the telephone through which the call has been made. This restores the drop or shutter to its normal place and puts the operator into communication with the caller. When the calling plug is put into the "spring jack," representing the caller's telephone, she moves the lever which rings the bell, and as soon as he answers, puts the parties into communication with each other. When the communication has terminated between the subscribers, a short ring by one or the other of them causes another "clearing out drop" to fall; then, for fear the subscriber may want to call for another number, the operator presses upon a listening key and asks, "Through?" and, getting no response, takes down the connection by removing the plug from the "spring jack." When the parties are through talking, and the operator who received the call has removed the plug from the "spring jack" of the telephone of the caller, a colored light, denoting the section which first called, will appear before the operator, notifying her that the transfer should be removed from

THE DELMARVIA TELEPHONE EXCHANGE, WILMINGTON, DEL.



THE DELMARVIA TELEPHONE EXCHANGE, WILMINGTON, DEL.
(Switchboard Built by Western Telephone Construction Co.)

the spring jack. This transferring requires only a few seconds time to connect any two telephones. An operator can reach and control, without changing position, the connections of over 300 subscribers' instruments.

In connection with the switchboard there is a chief operator's desk, which is connected with every operator's section and every subscriber's telephone. When a drop falls, showing a white light at the operator's section, a colored light appears on the chief operator's desk, indicating the section at which a call has been made. Should this colored light remain an unusual length of time, the chief operator, by pressing a button, opens communication with the operator at whose section the apparent delay occurs, and immediately ascertains the cause for the failure to make the called-for connection. The chief operator is thus aware of the working of the whole switchboard.

Every morning at 7 o'clock the lightning arresters on the cross-connecting board are carefully examined, to see whether any of the fuses have blown out during the night, thereby cutting out any of the subscribers' lines from the switchboard. Also every morning at 9:30 the operators call up the subscribers in order to ascertain whether the lines are working properly. The replies to these inquiries are sent to the chief wireman in the cross-connecting room, and lines are tested by a peculiarly constructed plug, both toward and from the subscriber's telephone to locate any injury to the lines.

The working of this system has been successfully inaugurated by the Delmarvia Telephone Company, and although in operation but a short time, it has already made the new line very popular.

The company has erected 400 telephone poles, upon which about 450 miles of No. 12 B. & S. hard drawn copper wire, and about 50 miles of cable have been strung, and 175 miles of underground conductors, connecting all overhead lines at the various terminal poles with the central office, have been laid. The conduits containing the underground cables are of vitrified clay, which will not rust or rot, nor can they be attacked by electrolysis. These conduits are protected from mechanical injury by being laid in a base of cement from three to five inches thick, and under a covering of the same material, making protection which is impervious to pick or shovel. The underground cables are of the National Cable Company's manufacture, each one containing 100 twisted pairs of No. 19 B. & S. copper wire, paper insulation and spirally wound. The switchboard and instruments were manufactured by the Western Telephone Construction Company, of Chicago.

The officers of the company are Thomas McCorkle, president; Charles N. Trump, vice-president; Henry Baird, secretary and treasurer; Capt. Frank Wood, superintendent. The directors are: Henry Baird, John Barron, Henry C. Conrad, Thomas McCorkle, George I. Speer, Calvin I. Swayne, Charles N. Trump and Charles E. Phelps, Jr.

On the Electrical Conductivity of Metallic Conductors.[1]

BY EDOUARD BRANLY.

THE remarkable experiments in wireless telegraphy made by Marconi have called attention to the conductivity of discontinuous metallic substances, and to the experimental study of it first made by me in 1890 and 1891. Marconi used my tubes and filings without modifying their method of working, and even if the special mixture of the metallic powders to which he gives the preference seems advantageous, it is easy to recognize that such a complicated mixture is not necessary, and it appears to me that the sensibility must chiefly be attributed to the state of conductivity of the powder employed. Having already[1] stated the conditions which increase the sensibility, I have now just taken up the matter again, and have confirmed my former results by new experiments. I have recognized that the most sensitive substances are those which offer a very slight conductance as compared with that of the galvanometer, and in several cases to attain this I have exercised, by means of a weight, a pressure of from 50 to 100 grms. on a layer of filings from 1 to 2 mm. thick, enclosed in an ebonite cup between two metallic electrodes. I obtained in this manner, with a circuit made up of the powder, a Daniel cell and a sensitive mirror galvanometer, a deflection of a few millimetres on the divided scale. With mixtures of insulating and metallic powders, when the proportion of the former was great, this limiting state was only reached with enormous pressures.

As a matter of fact, I did not trouble about measuring the pressure exerted. I enclosed the metallic filings in a narrow ebonite chamber placed vertically, the filings being as usual between two metallic rods to serve as electrodes, one of which could be moved forward or backward at will by means of a screw. I turned this screw until a very slight conductance was established. The apparatus, which was well constructed by M. Gendron, worked most satisfactorily. It allows of rapid manipulation, enables the powder employed to be varied, and dispenses, for the purpose of experiments, with a delicate tube analogous to those used by Marconi. Sometimes it is difficult to limit to a few millimetres the scale deflection obtained on tightening the screw; but if the conductance obtained corresponds to an elongation of 50 to 100 divisions, it can be reduced by a slight shock. The needle of the galvanometer returns to zero, and then, although the conductance is 0, the substance is in reality in the same condition as if it offered a slight conductance. For the moment I am not trying to synchronize the oscillator and receiver, nor to parallelize the electric radiation, as would be necessary for transmission to a great distance. I am confining myself to subjecting successively my apparatus and a tube of Marconi's alloy[3] to the same action, ususlly that of a spark from a small Wimshurst machine (plate 35 cm. diameter) placed at a distance of 25 metres. As formerly, my filings are sifted, and the better they conduct the finer they are taken. Many metals and alloys of definite composition give very good results. Aluminum and aluminum bronze behave well, but they are not the only ones, and it would be necessary, in order that the enumeration might be useful, to give not only the name of the metal but also the coarseness of the filings suitable and even the age of the filings.

In 1891[4] I emphasized the properties of metallic powders surrounded by insulators and agglomerated by fusion. These properties were the same as those of metallic powders plunged in air or a rarefied gas. The variations in conductivity of these solid substances occur under the same circumstances, and they also disappear on receiving a shock or on being heated. My experiments do not appear to have been repeated. I had moreover to grope my way to a certain extent in the beginning. If Lodge had in his turn experimented with solid substances he would probably have renounced his term "coherer."[5]

The mixtures of filings and insulators can be varied in a variety of ways: resins and filings, shellac and filings, balsam and filings, etc. I often give these mixtures the form of pastilles of about 1 mm. thickness and 2 or 3 mm. in diameter. Instead of pastilles it is very convenient to use thin sheets of collodion and filings, gelatine and filings, celluloid and filings, etc. The preparation of these sheets is very simple and rapid, and allows the proportion and coarseness of the metallic grains to be varied at will. Whether pastilles or pellicles be used, they are treated in the same way as the powders. They are placed between the electrodes of the screw apparatus mentioned above, and the screw is turned until a very slight conductance is obtained. If necessary, this conductance is destroyed by a shock. The sensibility may be extremely large, equal or greater than that of the most sensitive powders.

I do not insist on the sensitization by the first effect; this is a point of great importance mentioned several times in previous publications. Let us also note that the intensity of the shock to produce the return must be regulated. It is needless to remark that the value of the continuous current traversing the sensitive substance plays an interesting part; special effects are obtained on reducing the electromotive force to one-twentieth, one-fiftieth and one-hundredth of that of a Daniel cell or on using thermo-electric currents. I will add that mixtures can be obtained which only remain conductors for a moment and return immediately, without requiring a shock, to their original resistance. It ap-

[1]From the Comptes Rendus of December 6, 1897.

[2]See two articles on the variations of conductivity under electrical influence in La Lumiere Electrique of May and June, 1891, Vol. XL., 448. A resumé of the principal phenomena was published in the Bulletin des Séances de la Société Francaise de Physique, 1891, pp. 135-141.

[3]I am using a tube made in London according to Marconi's instructions. It is much more sensitive than some others produced in the same way, and it was placed at my disposal by M. Ducretet.

[4]Comptes Rendus, January 12, 1891.

[5]My tubes of filings received the name "coherers" from Lodge, and this name has been generally accepted. The expression is based on an incomplete examination of the phenomenon and on an inaccurate interpretation. I proposed the name "radioconductors," which recalls the essential property of discontinuous conductors of being excited by electric radiation. M. Ducretet uses my various radioconductors in the apparatus he has constructed to realize "Hertzian Telegraphy" without wires.

pears even that effect can be produced with any substances by varying the method of operating in a suitable manner.

The Great South Bay Postal Submarine Cable Successfully Laid by the Okonite Company.


Marine Observatory Tower at Fire Island.

On January 25 the six-mile submarine cable of the Postal Telegraph-Cable Company was successfully laid by the Okonite Company in Great South Bay, on the Ocean side of Long Island, between Fire Island and Conklin's Point. This cable is the heaviest of that kind ever manufactured, and due to the dangerous character of the Great South Bay the job of laying the cable was one of the most difficult pieces of submarine cable work performed in recent years in this part of the globe. On account of the many problems involved and the responsibilities of such an undertaking, the Postal Telegraph-Cable Company requested the manufacturers of the cable to lay it themselves. This the Okonite Company agreed to do, and the successful completion of the work reflects great credit on the general management and careful engineering of the undertaking.

The Postal Telegraph-Cable Company have recently established several marine observatories just outside the port of New York for the purpose of reporting the arrival of steamships at the earliest possible moment. The most exposed and distantly located of these observation towers, shown in Fig. 1, has just been completed at Fire Island. A substantially constructed air line runs from this observatory, which is located on the Ocean side of Fire Island, to the Bay side of the Island, where it connects with the six-mile cable just laid. This cable crosses the Bay and lands at Conkling's Point. Here it connects on a terminal pole, shown in Fig. 2, with another land line which runs due north to the Long Island railroad tracks. This land line is a splendid example of modern telegraph construction and carries two copper wires weighing 210 pounds to the mile. From the point where the land line meets the Long Island railroad tracks, it follows an old overhead line for some miles along the railroad, then along the highways until the outskirts of Brooklyn are reached, where it goes underground to No. 4 Court street, Brooklyn, one of the Postal Company's offices. From here the line runs via an aerial cable, carried on the elevated railway structure, to the Brooklyn Bridge, thence over the Brooklyn Bridge by another aerial cable to the New York terminus, from where it goes underground to the Postal Company's main office at 253 Broadway, New York City. Before reaching this office, however, this important line has passed through several towns on Long Island and three of the boroughs of Greater New York.

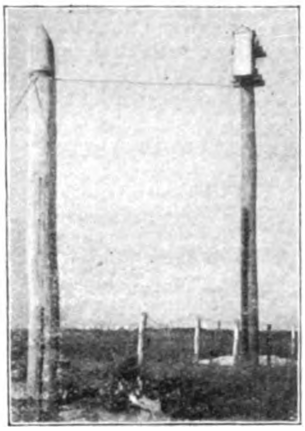


FIG. 2.—TERMINAL POLE AT CONKLING'S POINT.


FIG. 6.—LAYING THE SHORE END.

To get a clear idea of the amount of preliminary work and planning required for the successful carrying out of this undertaking, it will probably be as well to follow the cable on its journey from the Okonite Company's manufacturing plant at Passaic, N. J., to its final resting place in the waters of the Great South Bay. The cable, which is six miles long, was made in one length, and weighs about sixty-five tons. It is one inch and three-quarters in diameter, contains six Okonite wires arranged as three pairs, and is heavily armored with galvanized iron wire. The cable weighs four pounds to the foot, which is about five and a half times the weight of an ordinary ocean cable. An elevation and cross section of the cable are shown in


FIG. 4—WINDING THE CABLE ON REEL AT FACTORY.


FIG. 8—GUIDING BLOCK FOR PAYING OUT CABLE.

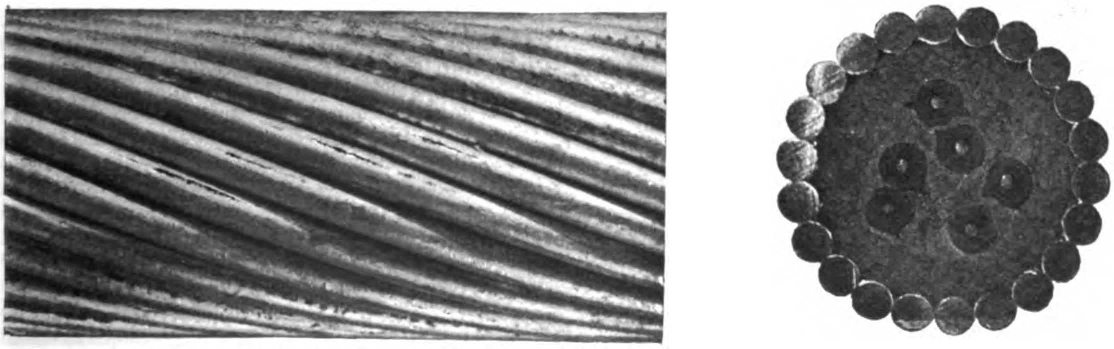


FIG. 3.—SIDE VIEW AND CROSS SECTION OF OKONITE POSTAL CABLE.

Fig. 3. The cable as manufactured was coiled in the large testing tank at the Okonite Company's factory and put through the usual severe tests. After satisfactorily passing through these, the end of the cable was led through a window to a heavy reel erected on bearings on a flat car alongside the factory buildings. A leather belt was passed around one end of the reel and carried through the window to a shaft in the factory, as shown in Fig. 4. By this means the reel was turned and the cable was wound upon it. It required three of these reels and three flat cars to transport the cable.

From Passaic the reel laden cars were transported by as direct railroad connection as possible to New London, Conn., where they were run out on a pier and the cable was unwound and coiled on the deck of a large wrecking scow, shown in Fig. 5.

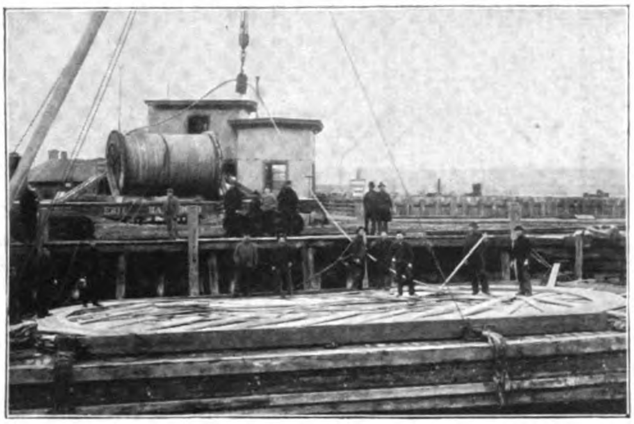


FIG. 5.—COILING CABLE ON SCOW AT NEW LONDON.

Such a roundabout road had to be chosen because New London was the nearest point at which a scow of the requisite size and of sufficiently light draft could be obtained. This was made necessary owing to the shoals and sandbars in the Great South Bay over which a heavy draft scow could not pass. Capt. T. A. Scott, the famous New London wrecker, was in charge of this part of the work and the skill he displayed in handling the heavy mass of material was truly wonderful to an observer unaccustomed to this class of work. The scow was eighty-five feet long, thirty-five feet broad, and drew about three feet of water with the sixty-five tons of cable on its deck. The cable was passed from the reels on the cars through a heavy snatch block suspended from a derrick on the scow and was coiled on the deck without a kink in six layers, containing about a mile each. This is the first time, it is believed, that a cable of such length and size has been laid in such a manner. Heretofore, heavy reels have been used with various degrees of satisfaction. The manner in which the cable was paid off from the deck of the scow in laying left no doubt in the minds of the experts who were present as to the success of this method.

FIG. 7.—PAYING OUT CABLE FROM SCOW.

When the cable was coiled down and made fast, the scow was taken in tow by a heavy, sea-going tug and towed down the Sound to Fire Island. The scow was anchored near the terminal pole of the Fire Island land line and a heavy rope was carried ashore in a small boat, passed through a pulley made fast to the terminal pole, and carried back to the scow. The rope was attached to one end of the cable, the other end of the rope being passed around a steam winch. In a very few minutes after the winch had started, the end of the cable was ashore, where it was made fast, as shown in Fig. 6. A light draft tug drawing but four feet of water was then made fast to the scow and the tedious, risky and "tricksome" journey across the Great South Bay was commenced with all its possibilities of mishap.

The tug was piloted by an expert bayman, Capt. George Saxton. Owing to his thorough knowledge of the channels and bars the cable was successfully laid in the wonderfully short time of four hours without a single hitch or delay from any cause. The cable was paid out over the stern of the scow in much the same manner as it was carried aboard, see Fig. 7. A guiding block, shown in Fig. 8, was rigged up on the stern of the scow through which the cable passed and an extemporized brake was used to regulate the speed of paying out.

Valuable assistance was rendered in the shipping and laying of the cable by Mr. R. D. Blish, the cable expert of the Southern New England Telephone Company, and the laying of the cable was witnessed by Mr. E. B. Baker, general superintendent of the Southern New England Telephone Company, who was greatly pleased with the methods and means used. Mr. E. G. Cochrane, general superintendent of construction for the Eastern division of the Postal Telegraph-Cable Company, was present, as well as Capt. W. L. Candee and Mr. George T. Manson, of the Okonite Company.

MUNICIPAL AFFAIRS

Public Control, Ownership or Operation of Municipal Franchises?—VII.

With Special References to Electric Lighting.*

By R. R. BOWKER.

(Vice-President and General Manager New York Edison Co.)

THE true objection to trusts is not economic, but financial and political. The enormous advances in water and gas stocks show that in these cases the social increment value has in fact gone, not to the public, but into private pockets. It is not always the original investor nor indeed the present investor who profits by such advance, for with increasing profits and a diminishing rate of interest the price of the stock goes up until it pays only a normal return, but more probably the speculative "operator." But this objection can be fairly met by the limitation of franchises and the fair regulation of prices, limiting the return say to ten per cent. on actual investment, with proper depreciation and amortization allowances, or providing that profits above a normal return shall be shared with the municipality. The latter is the better way, because it leaves to private management an incentive to efficiency and economy, and like economic rent it does not tend to increase price. Such regulation should be not by legislative interference, but by provision in the grant or charter. Private corporations doing public service should also be required to print full reports. These provisions would tend to assure fair prices, prevent over-capitalization, and leave little margin for corruption.

It is rightly urged in favor of municipalization that a city can borrow for investment purposes on its bonds at a very low rate of interest. But it is evident that a private company, safeguarded by reasonable conditions, can borrow on its bonds on almost as close rates, certainly within one per cent., and the higher rates have been chiefly because of the uncertainties incident to our American methods. The increase in market value of stocks as dividends have increased, show that in a well-settled business, as that of the London water companies and the New York gas companies, the shareholders in a private com-

*This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public-service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any outside the business cited, in an academic discussion, to obtain real bases of comparison.—Reprinted by permission from Municipal Affairs, the Reform Club Quarterly.

pany no longer obtain much above the normal rate of interest, which is steadily decreasing.

POLITICAL OBJECTIONS TO MUNICIPALIZATION.

The final and strongest argument against municipalization is, even more than against trusts, political rather than economical. The charge against private corporations that many of them have been among the worst breeders of political corruption is, in some but not in all cases, probably true. This is in great part the fault of public opinion. The public does not pay adequate salaries to its legislators. Men taken from their personal business during the earning months of the year do not receive enough for their living and their campaign expenses. Those of honest purpose find it not easy to resist the "opportunities" offered them by clever lobbyists, while the less scrupulous, sent both from city and country districts, almost openly take or ask money bribes. Public opinion lends an easy sanction to the fallacious argument, that it is better to surrender to highwaymen a part of the property in one's charge than to lose it all, which permits men of the highest personal integrity and honesty to condone or overlook, through an indirect chain of agents and lobbyists which evades responsibility, what they would not personally or in their own private interests permit. It is indeed highly to the credit of our legislators that so many, under such temptation, are ready, as I have found, to protect a corporation against "strikes" when it is honestly trying to serve the public and is prepared to make its facts and figures fully known. But to take passage on a pirate ship so as to avoid danger from pirates, is not altogether wise, and to give over an industry to the spoilsmen by municipalization so as to prevent corruption, is scarcely the common sense or commendable course.

The opportunities for and invitations to political corruption in our great cities and in our state legislatures, if great industries now in private hands are taken over by the city or the state, would be the most serious menace possible to really democratic and American institutions. In the past few years the growth of paternalism in our government, and of the restrictive policy in our trade relations, foreign and domestic, has turned American thought unconsciously toward what is practically state socialism, the direction or misdirection of the affairs of an individual or an individual enterprise by governmental machinery. The American theory of government is based on individual freedom, the right of an individual to manage his own affairs without interference, unless he interferes with his neighbor. Democracy and socialism are in this sense absolute contraries. Only a generation ago this country freed itself from one form of industrial slavery; it is the great argument against the municipalization of industries that it would be not only a step, but a long stride, toward the new industrial slavery of state socialism.

Tonawanda, N.Y., Votes Down a Municipal Plant

The Tonawanda Board of Trustees decided recently to submit a proposition to the taxpayers of the village at a special election to be held on January 29, providing for the issue of bonds to the amount of $25,000 for establishing a municipal lighting plant that will generate power for 225 lights. The vote was duly taken and resulted as follows: For purchase of city plant, 65; against, 324. A very reasonable proposition made by the local company and already noted in these columns will probably be accepted.

Some Municipal Examples.

Debate is on in Des Moines concerning municipal ownership of a gas plant, and the court house is the forum for Sunday afternoon addresses on the subject before the members of the Union Labor League and others. J. S. Polk, the talker on a recent Sunday, warned his hearers to avoid the first step into uncertainties, if not failure. The logical sequence of municipal control of light supply was municipal control of water, of street railways, and of all the other "public utilities." That such control elsewhere was rarely successful, Mr. Polk proceeded to show. In Alexandria, Va., he said, the city sold gas at $1.62 and lost $6,239.03; Philadelphia sold at $1.50 and lost $106,144; Richmond sold gas at $1.50 and lost $42,405.97 annually. As to street railways, none are owned by municipalities in this country, and only four in Germany, the centre of advanced socialistic thought, and those in small cities. In Switzerland there are three. In no other European country are any owned by municipalities, except in Great Britain, where there are six, as against 125 owned by private concerns. Of these six cities, Blackpool has operated at a profit of $992 a year. Huddersfield has lost $311,000 in fourteen years. Leeds has netted a profit of about two per cent. Plymouth lost $5,430 last year. Sheffield has not paid interest. Glasgow paid interest on £515,556 and netted about $50,000. It must be considered also, in this connection, Mr. Polk said, that both labor and capital are cheaper in England than they are here, and that higher rates of fare are charged. Under the tramway act of Great Britain these roads are allowed to charge two cents a mile for transporting a passenger, there are no transfers, no tickets are sold at a discount, and the longest ride in any one of the cities (Glasgow) is five miles, for which the city charges six cents.

LETTERS TO THE EDITOR

R. M. Hunter on Railway Motor Support Patents.

THE recent decision of Judge Wheeler in the case of the Sprague Electric Railway & Motor Co. vs. the Union Railway Co., et al., involving the motor support under the Sprague patent, is far more important than the Walker Company endeavors to make out or admits in its published criticism of the decision. The Walker Co. should not play the ostrich act and think, because it prevents itself seeing by burying its head in the sand, others are to be reduced to the same condition. Now this Sprague patent is of fairly early date, and aside from the question of who actually invented the device, the features involved are patentably different from the prior art set up, not only specifically in the direction pointed out by Judge Wheeler, but generically also. The construction involving the hinging of the motor to the axle by bearings connected to the field magnets and having a revolving armature supported within the field magnets at a distance from the axle by suitable bearings movable with the field magnets, whereby the armature shaft (in which the power originates) is always maintained in the same axial relation with the axle and continuously connected to it through gearing or other power transmitting devices, and further, in which the free end of the motor, together with the power shaft (the armature shaft), is flexibly suspended either from the vehicle body or truck frame, is novel, useful and clearly distinguishable from the prior art. It is peculiar to the art of electric propulsion and differs radically from the Adams 1883 patent, and is "independent" of it as Judge Wheeler says. I may add that looking at the improvement from a legal standpoint, the construction to be given to the claims sued upon, takes the structure covered thereby beyond the pale of the prior art, and clearly distinguishes from all those alleged anticipating devices comprehending the hinging of the engine or motor upon the axle, which is also made to subserve the function of the power shaft. The Walker Company may play with words, but the cold, hard facts remain that the motor suspension in common use embodies invention generically, provided we do not divest it of its useful elements. The idea that the Court intended to confine the scope of the decree to such narrow limits as to require specific brackets directly bolted to the pole pieces as bearings for the armature shaft, is believed too flimsy to be worthy of serious thought. A patentee is entitled to common sense equivalents, and the modifications in design of the motor since the date of the Sprague patent should warrant some liberality. In any event the bearings are in all cases rigidly connected directly or indirectly with the pole pieces to the extent of keeping the armature in the proper relation therewith while otherwise movable relatively to the axle, and this is all that is required. If the Walker Company wishes to deceive itself it must not try to lead others astray also.

R. M. HUNTER.

Philadelphia, February 7, 1898.

DR. LOUIS DUNCAN, of Johns Hopkins University, has become consulting engineer of the Third Avenue Street Railroad Co., New York, for its plans for an extensive system of conduit trolley traction.

THE

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A Splendid Electrical Exhibition.

IT is as we ventured to predict a month or two ago in regard to the Electrical Exhibition that will be held in Madison Square Garden next May. The matter has been taken up with the greatest energy and interest by the whole art and industry, so that already the management is able to issue its preliminary list of over 100 exhibitors, whose allotments of space represent between 20,000 and 30,000 square feet. This is a really wonderful showing, being not less than five times as great as at the corresponding period two years ago. Those who do not now hasten to preempt the little space unoccupied will certainly find themselves badly left in an exhibition destined to attract a great number of people and sure to have a good influence on all the electrical lines of trade.

The list printed in our pages this week presents an impressive collection of the leading names in the art and guarantees some very fine exhibits. There will evidently be a good demonstration of electric power uses. This is admirable, for it is a lesson which at this moment of reviving trade can be driven home, leading to the choice of electricity for power distribution in new and old manufacturing plants. Of methods of current generation there promise to be not a few, including not only the old dynamo, but its later competitors. The most interesting developments, indeed, may be expected in regard to the engines shown, for it is plain to see that gas or oil engines may score this time not less heavily than did the steam engines at the show in 1896; and the novelties in this line will attract widest public attention. In electric railway work again some most interesting exhibits will be displayed, including several ingenious methods of perfecting the underground trolley and the third rail system. In lighting, we think some beautiful, novel and startling effects, with direct application in the art, may be safely expected. The tremendous gains of business on the part of the local lighting companies throughout New York show how ripe the public is for practical persuasion to use more electricity than ever before.

And so we might go on, in review of this remarkably encouraging list of foresighted exhibitors who have already put themselves in line and looked out for good spaces. But aside from the commercial aspects of this exhibition, there are its educational features, and these in the excellent hands of the New York Electrical Society, supporting the Auxiliary Committee, are already being carefully developed. At an early day, the management will announce its plans in this department, but meantime it may be said that no electrical show ever held previously will have made any such effort in behalf of the art to inform the intelligent public, and to interest the younger members of the community in the great agency which will dominate their life far more than it has that of those of us who have grown up during the forerunning age of steam.

One other feature may be noted here. They who regard this exhibition as "merely local," if there be any such, make the greatest mistake in the world. No one says or thinks that of a show in London or Paris; no one has any reason for regarding as local an exhibition held by manufacturers from all over the country, amongst over 3,000,000 resident population, and in one of the greatest of our exporting cities, at a time when the foreign demand for our electrical, steam, hydraulic and machinery products is increasing by leaps and bounds. The markets north and south of this country are not yet as fully ours as they should be by any means; and while we are selling such apparatus in large quantities to England, France and Germany, those countries are still getting orders that should be ours, all the way from Florida to Patagonia, to say nothing of the Far East. To convince export merchants of their opportunities in the electrical line, will be one of the benefits of this exhibition, and not its smallest; while we happen to know of the intention of foreign purchasers to visit it and make the most of the occasion. Consumers visiting this country to give contracts for apparatus dislike greatly having to travel long distances to see some of it, and at this show they will find in profusion the objects they seek and want to buy.

Some Considerations on Diesel's Rational Heat Motor.

IF we should plot a curve representing the increase of efficiency of any one class of machinery such as the dynamo or steam engine, for example, letting the ordinates represent the years and the abscissæ the efficiency, we would find that the curve is remarkably regular, devoid of any sudden change of direction. In fact so regular has this curve been for the steam engine during the past quarter century that the increase of efficiency during a coming year could be predicted at the end of the one that preceded it. This fact has had the effect of causing engineers to regard with incredulity any reported sudden increase of efficiency of any class of machines, especially prime movers. For many years the dynamo and steam engine have been developed side by side and it may even be said that the development of the latter is due to a large extent to the rapid strides which have been made of late in raising the standard of efficiency of the former. The dynamo has now reached a state bordering closely on absolute perfection. The steam engine is one of the most perfect instruments of modern industry, brought to that height by the ablest engineers. Nevertheless, the best triple expansion steam engines of over 1,000 h. p. utilize only from 12 to 13 per cent. of the whole heat contained in the fuel, and small engines down to 50 h. p. only 5 per cent., provided condensation is used. The gas and petroleum motors, too, have received their due share of attention and their efficiency has now been brought up to from 20 to 30 per cent. This, according to Prof. Ewing can be raised, by following the proper lines, to 40 per cent., and regarding the great problem concerning steam generation, we may recall Redtenbacher's words, when he wrote to Zeuner, that "the principle of steam generation and utilization is wrong; it is to be hoped that at a time, not far off, the steam engine will disappear after we have acquired clear ideas on the nature and the effects of heat." These two statements, the

one by Ewing relative to the gas and petroleum engines, and that of Redtenbacher regarding the steam engine, justify the taking of a most optimistic view of the remarkable claims advanced for the Diesel rational heat motor which we describe and illustrate on another page.

The operation of this remarkable motor may be briefly described as follows: An auxiliary air pump compresses the air to about 500 pounds per square inch, storing it in a separate reservoir from which it is led into the cylinder along with the oil or gas or coal dust, and compressed still further, the temperature due to compression rising to the ignition temperature of the combustible. The fuel begins to burn and generates still higher temperature and pressure by doing so; at the end of the stroke the consumed gases, still at a high temperature, are led into a larger low pressure cylinder which brings the pressure down so low that the succeeding exhaust is comparatively quiet. With American petroleum this motor gave an efficiency of 34.2 per cent. as against similar motors of the ordinary type of 20 to 30 per cent. and the best steam engines of 12 to 13 per cent.

The fact that the Diesel motor works with nearly equal economy at light and full load is a strong point in its favor, while the absence of any igniting apparatus and its self-starting properties must commend themselves to all engineers.

The motor is to be shortly introduced into this country, and its advent is to be welcomed if it fulfils the claims of its inventor. We can discern distinctly its vast influence for good on the industry of electrical generation and distribution.

The Rights of Telephone "Deadheads."

A DECISION has just been rendered in Washington, by Associate Justice Cox of the Supreme Court of the District of Columbia, which ought to prove of some service in checking the impositions under which local telephone companies suffer. The proprietor of a hotel in Washington, as a subscriber to the telephone, allowed all the patrons of the hotel to use it free of charge. The amount of "deadhead" business was naturally very large under such conditions, and the company, failing to check it, tried to remove the instrument. A temporary injunction stopped them, but the judge in continuing the injunction has imposed certain requirements on the plaintiff, which, if respected, would remedy the evil. Before mentioning them, we will again express our own belief that a measured service is the only way out, the experience of the New York Telephone Company proving our assertion.

Judge Cox, for example, says that boarders in the hotel can send for a baggage wagon, but are not entitled to order theatre tickets or ask for stock reports. He points out that the guest in the hotel does not get free telegrams, or free cabs, or free messengers. Why, then, free telephones, simply because the instrument happens to be available? Why not free newspapers and free boot shines?

Judge Cox puts his finger on one point often forgotten in this land where liberty and license are not infrequently supposed to be the same thing: "When the subscriber allows others to use his telephone it is an abuse of the time of the telephone operator. It is also an infringement on the rights of the Bell Telephone Company, which receives a royalty from the defendant. Furthermore, it is an infringement of the rights of other subscribers. It is very annoying for a subscriber to call for a certain number and be told that the connection he wants is busy, that being due to the fact that a non-subscriber is using, free of charge, the telephone with which connection is desired." Some day it will be realized that all such encroachments are to be resisted, for the common welfare; and that the best way out is to pay for what you get, so that if anybody else wants to use your telephone he knows that, like a postage stamp, it is costing you three, five or ten cents, and that someone has to pay the bill.

Electric Enterprise in Small Western Towns.

THE rapid development of that portion of the United States which lies west of the Missouri River, and the utilization of the vast water powers of the mountainous regions, have again and again given evidence of the enterprising American spirit and the quick ability of our Western people to recognize that in the introduction of modern machinery lie the best possibilities of growth. It may therefore be of interest to note a few of these enterprising communities from a list compiled by "Cassier's Magazine," which gives ample proof of the above assertions. The town of Lander, in Wyoming, which had its progress impeded for want of the latest means of artificial illumination, ordered an electric light plant which had to be hauled over bridle paths for 150 miles from the nearest railway station before it reached its destination. Sheridan, also in Wyoming, had only 600 inhabitants and was 200 miles from the nearest railroad. The plant, packed in very small pieces, was hauled 200 miles. Buffalo, in the same State, having 600 inhabitants, thought 44 miles a comparatively short distance to haul its electric light plant.

In Idaho the town of Lewiston, with 2,000 inhabitants, had its electric light plant hauled on boats for 80 miles up the Snake River. Murray, with 700 population, had a 60-mile overland passage to accomplish. Turning to places on railways it is found that Newcastle, Cambria, Rawlins, Rock Spring, Green River, and Evanston, in Wyoming, and Pocatello and Idaho Falls, in Idaho, have each an electric light plant, though the population of not a single one of these towns exceeds 300. Boise City, Idaho, with 8,000 inhabitants, has not only an electric light plant, but a system of trolley cars. The three small mining camps of Cœur D'Alene, Wallace and Wardner use electricity for lighting purposes all the year around, while their available water power is used to run the mills for stamping ore. In winter when the main water supply is frozen, the electric current is connected with the stamping mills, and lighting and power are both furnished by a lavish expenditure on coal at $10 a ton. It is often said that one must go to Europe for examples of such small installations, but the far West is proof to the contrary; and the adverse conditions there met are, we imagine, far more severe than exist across the Atlantic, if only from the fact that these points are so remote from manufacturing centers.

Electric Versus Steam Elevators.

AT a recent fire in the city of New York another of the numerous advantages of the electric elevator was clearly brought to light and its presence might have avoided much loss of valuable property and the endangering of the occupants of the building. A number of tenants who were within some of the premises when the fire was discovered, endeavored to seek safety by signalling for the elevator. The latter, which used steam as a motive power, was not running at that time, and was useless as a means of escape as it would have taken a dangerously long time to get up sufficient steam to put it into operation. The firemen, who could have made valuable use of the elevator by carrying their hose on it to the upper floors, were compelled to climb up a number of steep stairs with it, helped by reporters, in order to reach the flames. However, had an electric elevator been installed in that building, the throwing over to the street mains, which run into every large office building to-day, would have taken only a few seconds. Life and property would be imperilled to a less degree if the public would realize the boundless advantages of the electric elevator, such as flexibility of operation, safety, and the rapidity with which it can be made ready for action. Besides, electric motors can be used instanter for pumps and hose.

MECHANICAL

The Diesel Rational Heat Motor.

An Important Advance in Prime Movers.

IT is well known that the steam engine after its inestimable work during the past centry and with the improvements it has undergone, during recent years, is still regarded as a lamentably wasteful and imperfect motor. In regard to its state of development, it is a well known fact that in the best triple expansion steam engines of over 1,000 h. p., from 12 to 13 per cent. only of the whole heat contained in the fuel is converted into actual work; only 9 per cent. from smaller double expansion engines down to 150 to 200 h. p.; 5 per cent. from small engines down to 50 h. p., provided condensation is used, and far less from the smaller steam engines and those without condensation.

The question naturally arises, what becomes of the remaining 87 to 96 per cent. of the coal consumed? In the first instance, 20 to 25 per cent. are partly lost in the furnace and partly in creating draft in the smokestack, incidentally also causing the smoke nuisance which is becoming more annoying from day to day, especially in large cities. The remaining 70 per cent. are lost through radiation at every point, through condensation and cylinder losses, friction, etc.

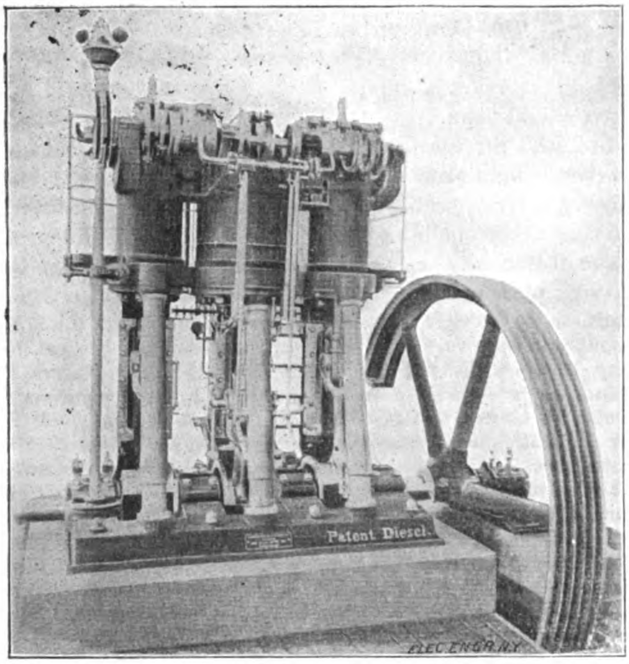
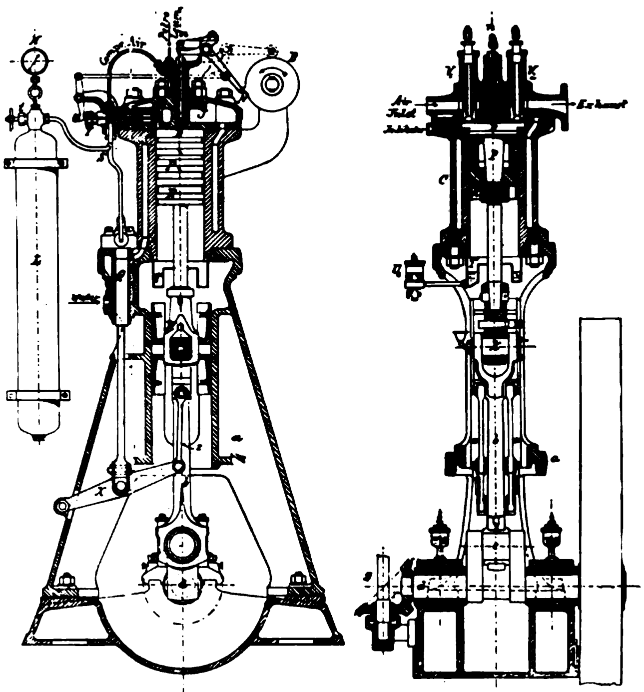


FIG. 1.—150 H. P. DIESEL RATIONAL HEAT MOTOR.—PERSPECTIVE VIEW.

A recent invention by R. Diesel, Munich, who has been working on the problem of heat motors for the last fifteen years, claims to have created a complete revolution in the production of power. The Diesel motor, which is no longer an experiment, but an established commercial apparatus, pretends to nothing less than to finally supersede the steam engine. For many years Mr. Diesel worked over this difficult problem until at last the idea struck him to use the air, which was employed as a working medium, not only as such, but simultaneously as a chemical medium, thus rendering it feasible to do away with the steam boiler. Thus he arrived at an idea which had long ago been applied in gas and hot air engines, namely the combustion of the fuel in the cylinder itself.

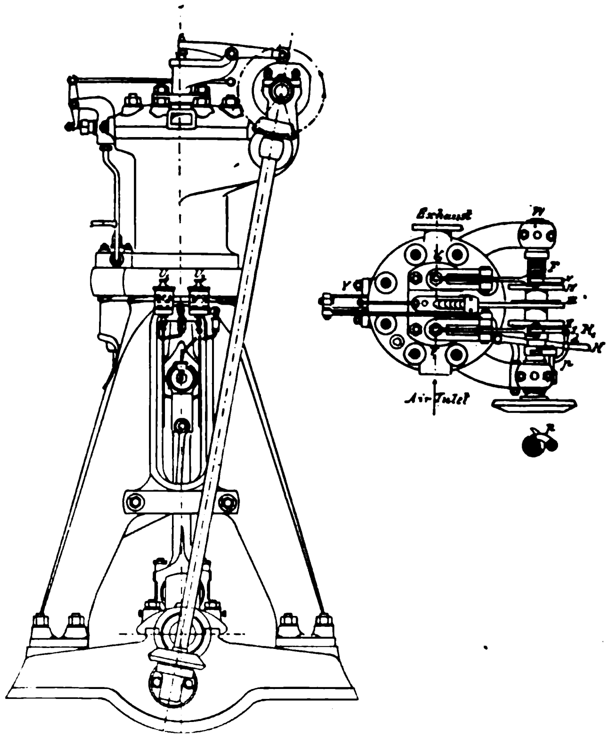
Before enumerating the four conditions pointed out by Mr. Diesel as the most important and fundamental ones for an economical caloric engine, it may be well to give his definitions of ignition and combustion. He states, in an address delivered before the Verein Deutscher Ingenieure:

In every process of combustion two kinds of temperatures are to be distinguished. 1. The temperature of ignition; 2. The temperature of combustion. The temperature of ignition is that temperature to which a fuel must be heated to ignite it in presence of air. The temperature of combustion is that temperature subsequently generated by the chemical process of combustion after ignition has taken place.



FIGS. 2 AND 3.—DIESEL RATIONAL HEAT MOTOR.—CROSS SECTIONS.

The conditions then named by Mr. Diesel are as follows: The combustion temperature must be generated not by the combustion and during the same, but before and independent of it after ignition had taken place, by mechanical compression of pure air. To deviate from the perfect process by directly compressing the air adiabatically instead of first isothermally from 2 to 4 atmospheres and then adiabatically to the 30 or 40 fold.



FIGS. 4 AND 5.—DIESEL RATIONAL HEAT MOTOR.—SIDE VIEW AND PLAN OF VALVES.

By so doing one realizes the first of the required conditions, i. e., the generation of the combustion temperature by mere compression with pressures which are two and four times lower than those used in performing the perfect cycle.

The fuel must be introduced gradually into the air which is compressed adiabatically to the combustion temperature in such a manner that the heat generated by gradual combustion is absorbed in the so-called nascent state, in consequence of a corresponding expansion, i. e., by mechanically cooling off the gases so that the period of combustion is going on constantly isothermally. It is evident that the fuel, in order to fulfil that condition, must be changed in its physical composition to a gaseous, liquid or powdery form. That is to say that through the combustion and during the same, no, or a relatively small increase of temperature is caused, an idea which seems to be absurd after having heretofore always effected the increase in temperature by the combustion and during the same.

The fourth condition also presents a revolution of ideas hitherto considered correct, according to which the combustion had to be carried on with as little surplus of air as possible, while he contends that a considerable surplus of air, whose amount can be determined theoretically in each special case, is necessary.

During the years 1893 to 1897 motors of various types and using different working media were constructed which would fulfil the above rational conditions. The petroleum motor completed in 1897 was extensively experimented with by experts and representatives of industrial establishments. All of these trials were carried on with the greatest accuracy, with repeated examination of all apparatus and instruments used, and with absolute conscientiousness. They lasted at times one, but mostly several days, and embraced all working conditions of the motor and its regulation under all complicated conditions.

In order to compare the efficiencies of the boiler engine transformation with those of the new motor, let us call n_1 the efficiency of the boiler; H the caloric value of the fuel, n_2 that portion of the whole heat n_1 H contained in the steam that can be converted into work; n_3 the so-called indicated efficiency, that is the portion of the theoretical cycle convertible into work; n_4 the fraction of the whole indicated work which the engine delivers at the flywheel, the remainder being absorbed by the friction of the engine, n_4 being therefore the mechanical efficiency.

In the comparison we will at once be struck by the following facts:

First: The efficiency of the steam boiler n_1 in the new engine equals 1, as the whole combustion heat of the fuel is transferred to the working body, air.

Second: The theoretical efficiency n_2 varies as has been proven in several instances, from 50 to 70 per cent.; the smaller value corresponds to the simple single cylinder engine represented in Figs. 2, 3, 4 and 5, and which, on account of its simplicity, has a very extended field of application; the larger value corresponds to more complicated arrangements, especially for compound system, which Mr. Diesel considers to be the only correct construction for those engines aiming at the utilization of heat. This value n_2 is twice as much as that of steam engines, and represents the superiority of the new motor over steam engines and explosion motors, whose value for n_2, according to Clark, varies from 33 to 43 per cent.

Third: The actual indicated work varies, according to experiments, from 34 to 40 per cent.; the indicated efficiency n_3 of this simple engine is thus 70 to 80 per cent., consequently, it is by far superior to that of the steam engine, and materially higher than that of the explosion motors.

Fourth: The mechanical efficiency n_4 of the new engine, varying between 71 and 75 per cent., is, therefore, materially less than that of the steam engine and explosion motors. It cannot, however, be denied, says Mr. Diesel, and there are good reasons for the supposition that the mechanical efficiency may gradually be increased to that of other engines. Be that as it may, for the present we only have to consider facts, and then give the economical result, which is:

$$n = n_1 . n_2 . n_3 . n_4 = 1 \times 0.50 \times 0.72 \times 0.74 = 0.266:$$

i. e., 26.66 per cent. of the total heat is converted into effective work.

As the fuel used for the experiments was usually refined petroleum, a comparison with motors of this kind only is permissible. The results of the tests have all been graphically represented and a careful study of them has justified the inventor in claiming the following advantages for the new engine:

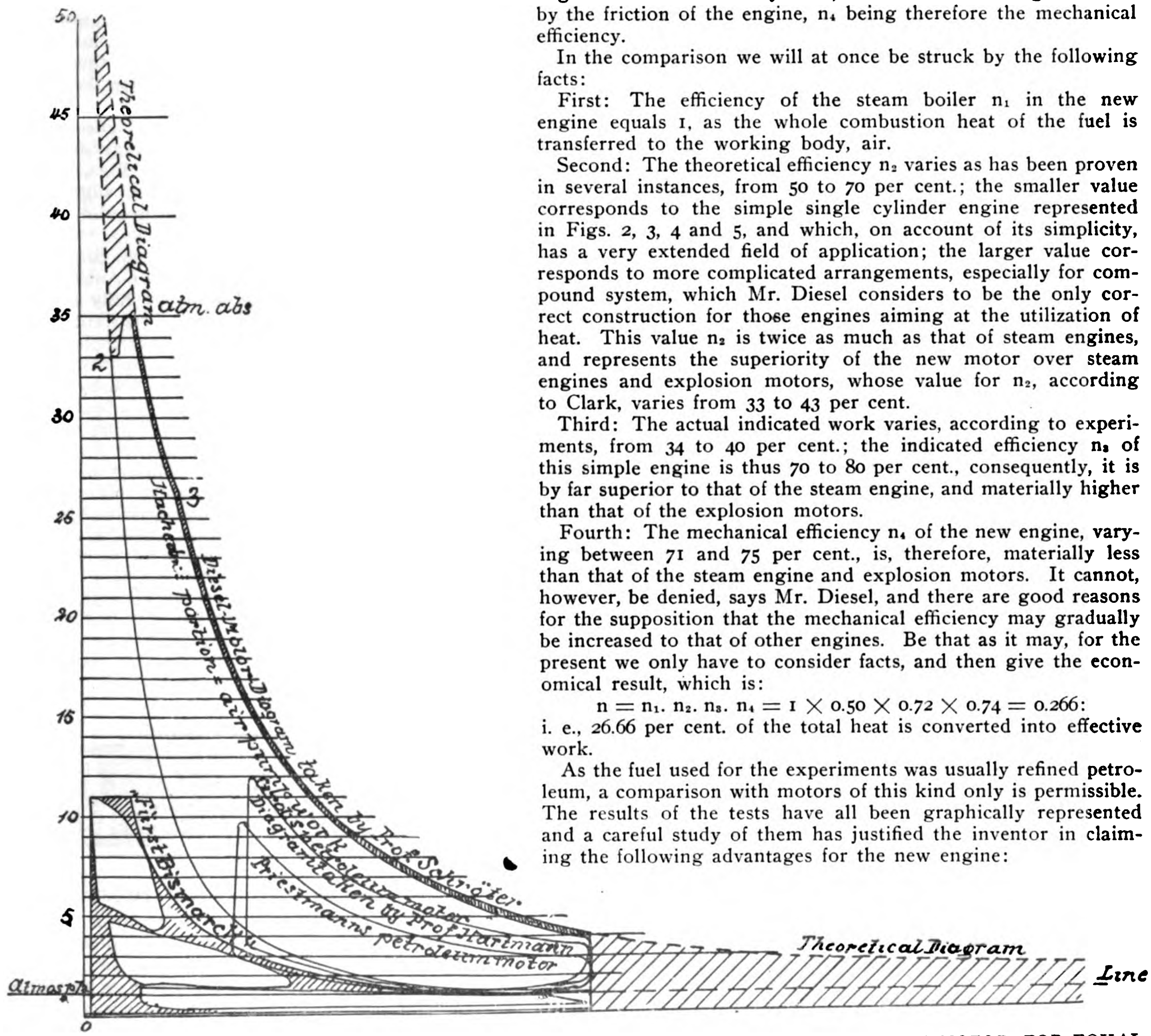


FIG. 6.—COMPARATIVE DIAGRAMS OF STEAM ENGINE, PETROLEUM MOTOR AND THE RATIONAL HEAT MOTOR, FOR EQUAL CYLINDER VOLUMES AND DRAWN TO THE SAME SCALE.

The first is, the very small increase in fuel consumption while the work is decreasing.

It can almost be expected that the consumption per horsepower, within the limits of the engines in practical use, is nearly constant, while with all other petroleum engines it increases enormously during diminution of load. This peculiarity is explained by the very strong increasing thermal efficiency accompanying decreasing work, whereby the loss of mechanical efficiency during less work is, to a greater extent, counterbalanced. No other engine has this peculiarity, not even the steam engine, and this is of vast importance; in practice, an engine never works with its highest load, and, therefore, in reality, never keeps up the results obtained during tests, nevertheless, the new engine is actually accomplishing this.

The second of the valuable qualities is its small dimensions, as compared with the explosion motors constructed up to the pres-

ent day. At full work the cylinder dimensions of the most successful of the motors are 50, 60 and even 100 per cent. larger than those of the new one, supposing, of course, all motors to have the same number of revolutions, as indicated by the diagram. This is proved, by Fig. 6, rendering conspicuous the diagram of the steam engine (ocean grey-hound "Fürst Bismarck"), of the petroleum explosion motor and the rational caloric motor. It is evident how the tendency prevails to draw out the diagram from the corner of the co-ordinate system into space. From the fact that the diagram of the new motor has, by far, a greater area than that of the explosion motors, its mean pressure is respectively greater, and the dimensions of the engine are smaller for the same work. The immediate consequence of this is, that the piston, connecting rod, flywheel-axle, etc., of the rational motor can be built not stronger, but weaker than those of the same capacity explosion motor. These facts remove the most important of the objections brought into the field against the new system, viz., that the dimensions would be so great as to be impracticable.

A third material advantage of the new motor is that the work can be regulated exactly as with steam engines, by changing the oil supply, i. e., the admission period. According to the work done the diagram becomes narrower or broader (for the actual scale see Fig. 6), and, indeed, the engine is controlled in an astonishingly exact manner by the governor, as the loading and unloading of the engine during the trials have proven. This has never been known to fail.

A fourth very valuable quality of the new motor is its continual readiness for service. As stated before, the motor in the condition that it was when last put out of action, and after an indefinitely long pause, is ready for starting without any heating or preparations of any kind whatever.

The fifth and, perhaps, best quality of the engine is the entire absence of interior soiling after continuous long service, due to the perfect combustion under conditions arising from the process. From this it also follows that the exhaust gases are entirely invisible and nearly odorless during the greater period of running, and only become visible when the engine is very much strained.

Less material advantages, but, nevertheless, advantages of great importance, of the new engine are: The absence of any ignition apparatus, whether electric, by flame or by incandescence; the absence of lamps, generating or pulverizing apparatus, of mixing apparatus, etc., and, in consequence, its simple construction.

These peculiarities, making the motor equivalent to the steam engine (but with the omission of boiler and appurtenances), are increased by its low fuel consumption, amounting to 215 grams (7.58 ounces avoir.) and less per brake horse-power hour, according to results obtained at normal working, and not when the greatest work is done.

Although the new motor may be regarded entirely developed as a petroleum motor, its field is still more extensive. It has already been mentioned that the running with illuminating gas was carried on just as successfully as with liquid fuel. Experiments to this effect have been made and the results can be produced at any time. The new engine will, however, first obtain its entire comprehensive importance when it is able to use common coal, and when it can be manufactured in units of 100 h. p. and more. In both directions experiments are being made by the machine shops at Augsburg; a large 150 h. p. motor has been built, Fig. 1, and a fuel gas generator is already built. The experiments themselves, and the development of the engines and apparatus for this kind of service, necessitate, of course, a great expenditure of time; nevertheless a comparatively quicker solution of these questions may be expected, in view of the vast amount of experimental material accumulated during a period of many years.

The experiments conducted with the motor by Professors Schröter and Gutermuth and others have shown an indicated efficiency in the utilization of 34 to 35 per cent. of the heat contained in the fuel under normal conditions, and 38 to 40 per cent. at half load; these figures are about 50 per cent. higher than the best indicated gas engine efficiency obtained up to the present (attaining, according to Dugald Clark, 27 per cent. in several cases, but generally remaining considerably below that figure), especially when taking into consideration normal conditions at varying and unusual loads.

The general plan of operation of the Diesel motor may be summed up in the following words:

Pure air is compressed in the cylinder of this motor, thus generating a temperature of about 600 degrees C. The fuel to be used, such as gas, petroleum or powdered coal is thereafter injected into the compressed air where it is gradually and completely burned up at a much lower temperature than ever before accomplished. During combustion and during the succeeding expansion, it is entirely turned into work. The injection and combustion of the fuel takes place as the piston in the cylinder begins its return stroke. It ceases when it has reached about one-eighth or one-sixth of its way back and it is so regulated that the increase in the temperature created by the compression of the air and subsequent combustion of the fuel, is reduced by cooling off due to the work done during the succeeding expansion. Thus, practically there is no increase in sensible heat since the heat caused by the combustion of the fuel is immediately turned into power and the motive power thus gained is only reduced by the small amount required for the compression of the air.

Our illustrations show one type of the Diesel motor in perspective in Fig. 1, cross sections of it in Figs. 2 and 3, and a side view of it and the plan of the valves in Figs. 4 and 5. Fig. 6 shows comparative diagrams of a steam engine, a petroleum motor and the Diesel motor, for equal cylinder volumes and drawn to the same scale.

Expert commissions from all civilized countries, including Japan and Australia, have been sent to Augsburg, where the motor has been in actual operation for fully a year, and their unanimous testimony indicates that its advent must be hailed as the beginning of a new chapter in the application of heat as motive power. The motor has been examined and warmly approved by eminent authorities, among them by Lord Kelvin, of Great Britain. It is expected that the suppression of boilers, coal bunkers and condensers, will revolutionize the machinery of torpedo boats and sea-going vessels.

At Nürnberg, Diesel's motors are being built at present for street cars and general railroad work. Mirrlees, Watson & Yaryan, the world-renowned marine engine builders, of Glasgow, are building reversible engines on the Diesel system, while European locomotive works are adapting the system for locomotives.

The Diesel motor has been patented in all countries where patents are granted for inventions and the rights for the United States and Canada have been acquired by a company since incorporated under the laws of New York State as the "Diesel Motor Company of America," with offices at No. 11 Broadway, New York. The motor will be one of the novelties at the May Electrical Exhibition.

X-Rays in Accident Insurance.

THE Röntgen rays promise to be of much help in determining the extent of injuries to policy-holders in accident insurance companies. One dishonest claimant injected irritants in his arm not long ago, and asked the company for a considerable sum for a broken wrist. A surgeon was employed by the company, and although the member was swollen considerably, presenting much the appearance of a fracture, the X-rays showed the bones to be in perfect condition. The patient was naturally chagrined at the discovery, but still thought he was entitled to $25, which was of course refused.

A still more interesting case was that of a New Orleans man who was thrown from his bicycle, fracturing his forearm. After considerable treatment a physician pronounced the bones united and the patient doing well. The latter, however, thought differently, experiencing sensations in his arm which caused him much pain and uneasiness. The Röntgen rays were resorted to, showing clearly that the bones had never united, and had not even been properly set. A splinter of considerable size was also found to be irritating the skin. The defect was soon remedied, and the period of disability for which the patient could make claim against the company consequently shortened. These cases are thought to have an important bearing upon such matters, since accident companies are constantly having suspicious cases to deal with, in which it has been heretofore almost impossible to determine accurately the justice of the claims made.

MISCELLANEOUS.

Waterproofing Fabric by the Electric Current.

Of the numerous commercial applications of electricity recorded recently, but few can compare favorably in importance with the use of the electric current for making fabrics waterproof or water-repellent. That this has been successfully accomplished has just come to our notice, and while we know of no severe tests to which the treated fabrics have been subjected, a description of the process and the experiments which led up to the discovery will certainly prove of interest and value.

Several years ago, Mr. Henry L. Brevoort, of Brooklyn, a well-known electrical and mechanical engineer and expert, made the following observation while employing pieces of wet cloth between conducting plates: After the cloth had become dry, and he wanted to wet it again, the cloth repelled the water as if the latter were mercury and had therefore become waterproof or water-repellent. The phenomenon led him to investigate whether a reliable process for waterproofing fabrics by electricity could not be devised. Mr. Brevoort commissioned Dr. L. K. Boehm to undertake these experiments, which resulted in perfecting a process of making fabrics water-repellent by means of the electrical current which, together with a theory to explain the action taking place, is described as follows: The process consists of the treatment of fabrics, threads, cords, or ropes of cotton, wool, silk, or other animal and vegetable substances, in the shape of fabrics or otherwise, by an electric current passing from a metallic conductor placed against one side of the goods when wet, through the goods, and to a conductor of metal or carbon placed against the other side of the same, whereby they are rendered water-repellent, and other useful properties are conferred upon the fabrics.

We will refer first to the sides of the goods being treated as positive and negative. By the positive side of the goods is meant that side which is to be against the plate or roller connected with the carbon of the battery (the negative element), or the like pole of a dynamo. By the negative side of the goods is meant that side of the goods which is against the conductor connected to the zinc (the positive element) of a battery, or the equivalent pole of a dynamo. The goods which it is desired to treat—say, cotton sheeting, for example—are wet with water, which is preferably neither alkaline nor acid. The wetted fabric is then placed between two conductors. The one on the negative side may be of metal or carbon or any material which is a conductor of electricity. The one on the positive side must be of metal capable of being oxidized, preferably aluminum, tin or zinc. The conductors, if they are in the shape of plates, should be accurately made, so that their opposing surfaces will press upon the goods at all points. Their shape is immaterial so long as this condition is present. If the conductors are rollers, they should be accurately turned, so as to bear upon the goods at all points along their length. A current of electricity is now passed from the positive side through the goods to the negative side. This current of electricity will, if of the proper strength and if applied for the proper time and when the conductors are pressing on the goods, confer upon the goods certain desirable properties or characteristics, among which may be particularly mentioned that it will produce a peculiar waterproofing or water-repllent effect thereon, which will be observed when the goods, after being dried, are again immersed in water. After the electrical treatment the goods are to be removed from between the conductors, which are not to be at any time during the operation in contact or short-circuited, and the said goods are then to be dried in the air or preferably a heated room or in an oven.

It is found that the goods are waterproofed, or their fibres are made water-repellent, at those points where the conductors were pressed upon them and where the current passed. This waterproofing is produced, it is believed, by the formation on the positive conductor of a metallic oxide of some kind produced by the liberation of nascent oxygen on the positive conductor, due to the electrolytic action of the current on the water, with which the goods are saturated, and which oxide enters into the goods or the fibres of the goods aided by the current, and probably is combined, partly chemically and partly mechanically, with the fibres, thereby making the same waterproof or water-repllent by the presence of the oxide in or on the fibres or in or on the goods. The strength of the current applied will depend upon the character of the goods submitted to treatment. Satisfactory results have been produced with cotton cloth, using one volt, and also with 100 volts, the period of treatment being shortened by the increased voltage. Voltages have likewise been used between these two extreme limits, and have had most satisfactory results with small conductors, say plates two inches in diameter, using a current of 30 volts.

Each specific piece of goods offers a different resistance to the passage of the current when in a wet condition, and different goods require different strengths of current. The theory of the process, as it is understood, is that the water absorbed by the fibres or the goods is electrolyzed by the action of the current, nascent oxygen is produced on the metal plate or roller on the positive side of the goods, and which is connected with the negative pole of the battery or dynamo (or that which furnishes the positive current), and nascent hydrogen is liberated on the negative plate or roller (which is connected to the positive element). The nascent oxygen acts on the metal plate or roller on the positive side of the goods, forming some oxide of this metal. This oxide is carried into or onto the fibres in the direction of the flow of the current, combining, probably, with the goods or fibres of the goods, and forming with or on the fibres a product which renders the various fibres composing the goods, and thus the goods themselves, waterproof or water-repellent. It is not known for certain whether the oxide is mechanically or chemically combined with the fibres, but it is believed that both effects are obtained. The nascent hydrogen on the negative side will, if the time of treatment is too long, accumulate and then begin to act as a reducing agent, and in case the period of treatment is prolonged beyond the proper time then the nascent hydrogen will reduce the oxide of the metal in or on the goods to the metallic state and the combinations or union of the oxide with the fibres will be destroyed by the reduction of the oxide to a metallic state.

It is very advantageous to place a sheet of fabric, such as cotton cloth, around the roller or on the plate on the negative side. By the use of this fabric the evolved hydrogen is mechanically kept from affecting rapidly the oxide in the cloth to be waterproofed, which latter is placed between this sheet of fabric and the plate or roller on the positive side of the goods; and in this way the period of treatment may be prolonged and the operation rendered less delicate, and such exactness is not then required as to time, and the general result is improved. This sheet of fabric may be continuously used until it is worn out, and if, at any time it is dried, is found not to be waterproofed. The fabric treated should have only a sufficient amount of oxide in it to make it waterproof. The proper strength of current varies with each specific material, its thickness, the time the treatment is to occupy, and the amount of pressure exerted on the goods by the conductors. The different metals require a different treatment as to time with the same current and pressure. While aluminum, tin, zinc, or those metals in general which do not stain white cloth noticeably, are to be used when the waterproofing effect only is used, for staining or dyeing the fabric metals such as copper, iron, silver, etc., are to be preferred. Such metals as copper or iron may, however, be used even when the sole purpose is to waterproof the cloth, provided it is colored cloth, and the alteration in color, due to the treatment by these metals, is not considered objectionable. Lead is not as serviceable for waterproofing as aluminum or tin, although it allows of the passage of a great quantity of current. Zinc gives fairly good results.

The degree of pressure to which the goods should be subjected may vary within very large limits; but it is always advantageous to have firm contact, such as would be obtained from a screw-press or a lever. With rollers the pressure should be regulated by bringing them forcibly together by springs and a screw or screws, so that the goods shall be in forcible contact with the conductors at all points where the current is passing. As to the amount of moisture to be employed, the goods should be thoroughly wet, though the desired result can be obtained with the goods in a damp condition. This process has the great merit of making the separate individual fibres and threads water-repellent, while the pores of the goods are in no way stopped up or closed. Consequently, if used on clothing, it

would not prevent evaporation taking place through the interstices between the threads.

Besides practicing the process on cotton, linen, woolen, and silk fibres, it is proposed also to apply it to string, sails of ships, sewing thread, and the like, treating such material as they pass over a conducting-roller and between a conducting-roller and one or more aluminum or tin rollers, preferably, on the positive side. Goods thoroughly waterproofed by this process will withstand considerable washing, particularly if the water is not too hot.

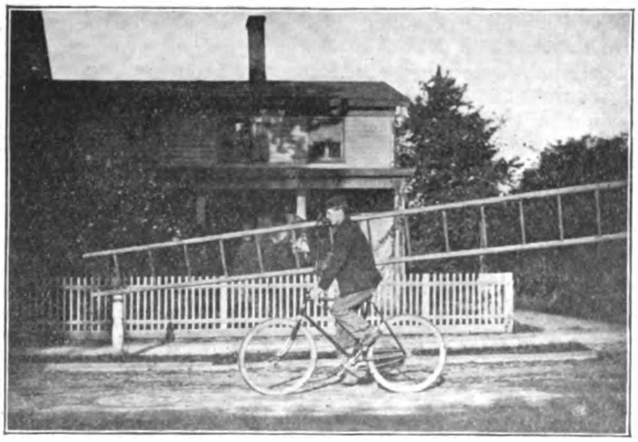
The above process has been patented in the United States and a company, called "The Electro-Waterproofing and Dye Fixing Co.," has been organized by some very prominent business men and financiers, who are now building some large machinery for commercially applying the process. We have ourselves witnessed some interesting tests with material thus waterproofed.

ELECTRIC LIGHTING

Harrison's Record-Breaking Lamp Inspection on the Bicycle.

IRVING HARRISON is a street-light inspector for the Hackensack Gas & Electric Co., of Hackensack, N. J. About two years ago he made his rounds with a horse and buggy. During April, 1896, he learned to ride the wheel and for more than a year has traveled over the route on his bicycle, falling back on the horse and buggy only after hard storms. His route of inspection covers a territory of about 50 miles, and includes the towns of Hackensack, Teaneck, Leonia, Maywood and Fairmount. He is required to cover this route daily and sometimes twice a day.

Mr. Harrison has traveled over 36,000 miles since April, 1896, up to December 31, 1897. Nearly all of this distance has been made while inspecting his lines. During the early part of 1897 he averaged 45 miles a day. In March he joined the Hackensack Wheelmen's Club, and at once entered the club's mileage competition. It was while riding in this contest that Harrison



HARRISON ON HIS LAMP INSPECTION TOUR.

started out to make a State record. He then began to run up the miles, and at midnight, December 31, had the satisfaction of beating the 1896 national record, 22,848 miles, with a grand total of 26,252 miles.

Harrison was greatly handicapped while covering a large proportion of the distance. Part of the time he was compelled to carry an 18-foot ladder on one shoulder and steady himself with his left hand. Other times he would cover mile after mile with a pair of climbers strapped to his legs.

The Century Road Club of America have recently published the list of contestants in the mileage competition. John H. George, of Philadelphia, takes the American record with 32,479 miles; Harrison has the New Jersey record with 26,252 miles.

Harrison's feat is more creditable than Mr. George's, as the latter had the assistance of a fellow rider on a tandem from July 1 till December 31, while Harrison made all his miles on a single wheel, had a ladder, climbers and lamp to carry, and had from eight to fifteen hills to surmount daily, as follows: To inspect Maywood, two going, one returning; Teaneck and Leonia, three going, two returning, including the famous breakneck Fort Lee hill. When the second trip would be made the lights on this hill were skipped.

Harrison holds the Hackensack Wheelmen's Club record for eight months (March 1 to November 1), with a grand total of 15,783 miles. He expects to establish a new club record for 1898. Every electric light man will wish him success, and even if they do not ride wheels all of them watch his progress with interest. It is only justice to add that the wheel ridden by Mr. Harrison is a No. 9 Crescent, made by the Western Wheel Works, of Chicago.

Phase Equipment of the New Consolidated Station of the Buffalo General Electric Company.

THERE is perhaps no topic of more general interest to the electrical engineer of America, and no achievement of which he is more justly proud, than the transmission of the current generated at Niagara to the city of Buffalo. Every new application of Niagara's current, every improvement in its mode of transmission and conversion, is watched with the keenest interest, and it therefore affords us great pleasure to be able to present to our readers to-day, through the kindness of Mr. Henry G. Stott, engineer of the company, full data regarding the equipment of the new consolidated station of the Buffalo General Electric Company, of Buffalo, N. Y., of which Mr. C. R. Huntley is the well-known general manager.

It has been practically decided that the new station, which will be built, will be upon the site of the old Wilkeson street station, on Wilkeson, Staats and Mohawk streets, where the company own a lot and old buildings covering 250 feet by 150 feet. At present two stations are running—Elk street and Court street—but both of these will be consolidated into the new station. Work will be begun immediately upon the buildings and pushed to an early completion, as the contracts for the machinery call for its delivery within three months. Eleven transformers of 250 k. w. each, stepping down from 11,000 or 22,000 volts to 352 volts, will be installed in the transformer house which will be built beside the new station. The voltage of 352 was adopted as a standard as being suitable for use in three-phase rotary transformers to convert to 550 volts direct current, as a very large business is anticipated in this current, 1,000 h. p. additional being expected in the first year. This voltage also lends itself to the use of synchronous motors of the revolving field type and frequency changers, without necessitating large collector rings and brushes, as the revolving fields only take from 10 to 25 amperes of 110 volts d. c.

The following apparatus have been ordered from the General Electric Company to begin the work with: Six 150 k. w. three-phase, 352 volt synchronous motors; rotary field type, to drive Brush 125 light arc machines. Twelve No. 12 Brush two-circuit, 9.5 amperes, 125 light, arc machines, two dynamos direct coupled to each synchronous motor, arc machines to have new automatic regulator, doing away with wall controllers, and making each machine self-contained. Eventually there will be 12 motors and 24 arc machines of this type. Two 200 k. w. rotary transformers from 352 volts, three-phase a. c. to 550 volts d. c. It is the intention to add to this as soon as the first two are filled up with 400 k. w. units. Three frequency changers, 400 k. w. each, to change from 25 cycles to 62½ cycles. These frequency changers consist of a 240 k. w. synchronous motor direct coupled to an alternator armature wound for 2,200 volts, this armature rotating in fields similar to those of an induction motor to which 25 cycle three-phase current at 352 volts is supplied.

The synchronous motor will drive this armature at 375 revolutions per minute, and as the fields of the alternator part have 12 poles, this will give a frequency of 4,500 per minute, and this, added to the 3,000 due to the Niagara generators, gives a total of 7,500 per minute, or 62½ per second; the synchronous motor of course driving the alternator against its inclination as an induction motor. The efficiency of these large combination sets or frequency changers is remarkably high, being from the 25 cycles to the 62½ cycles, 88 per cent. Switchboards are now being laid out at Buffalo and will be built by the General Electric Company when the designs are completed.

To provide for possible interruption, due to a breakdown in

the cable, duplicate cables will be run from Niagara Falls, and both will remain in use until some accident occurs to one, when an automatic circuit breaker, designed by Mr. Emmet, will throw out the faulty cable. This circuit breaker is entirely novel in design and will be operated by a small induction motor. They will be placed at both ends of the line.

Three-Phase Factory Transmission for the W. W. Kimball Co., Chicago.

MUCH has been said in the past few years about the advantages of multiphase motors, but it is doubtful whether the electrical engineer who has dealt always with direct current apparatus actually realizes the simplicity of a multiphase shop transmission system. To those who are skeptical about the merits of a three-phase shop installation a visit to the piano and organ factory of the W. W. Kimball Co., at Chicago, is to be recommended. No one who inspects the plant in service there can fail to be impressed with the suitability of multiphase apparatus to a shop transmission where it is desirable to have a number of motors operating with no attention paid to them beyond the usual oiling and superficial cleaning that machinery around a factory commonly receives.

The W. W. Kimball Co. is known the country over as large manufacturers of pianos and organs. Their factories are located at Twenty-sixth and Rockwell streets, Chicago. The consulting electrical engineer of the concern is Mr. F. D. Mack, who planned the present electrical installation, and who takes pride in being the first to put in operation in the West a large factory transmission using motors having no armature contacts and nothing which can lead to the starting of a motor hospital for the repair of commutators or collector rings.

At present only part of the factory is electrically driven, but the writer is informed that electric drive will very soon be used throughout the entire factory.

The electrical part of the power plant now consists of a 180 kilowatt three-phase Westinghouse alternator belted to an Allis Corliss engine. This plant is to be enlarged, however, by the addition of a direct connected alternator of 300 kilowatts capacity driven by a vertical Corliss engine at 100 revolutions per minute and having 72 field poles. The frequency employed in this plant is 60 cycles per second, or 7,200 alternations per minute. The generator now running is rated at 180 kilowatts at 400 volts, but the field strength has been increased so as to make the voltage at the switchboard 440. This was done to permit the use of standard apparatus for the lighting part of the system. Transformers are regularly made which will reduce from 400 to 100 volts. The factory was already lit with 110-volt lamps, so in order to continue the use of 110-volt lamps the generator voltage was raised to 440 to make the 4 to 1 transformers give 110 volts on their secondaries. The generator fields are excited by a small compound-wound direct current dynamo, and in addition to this have a set of coils supplied by a rectified current from an auxiliary winding of the armature which perform the same function as the series coils on a direct current compound-wound dynamo, viz., to prevent drop in voltage as the load is increased. The current for these compensating field coils is generated in a few turns of what may be called secondary windings of the armature. The stronger the current in the main armature coils the stronger the current in this secondary winding. This secondary current is led to a rectifier at the end of the shaft and from the rectifier brushes to the fields. The voltage of this current being low, there is little trouble from sparking at the rectifier.

From the generator the three main cables run to the switchboard, where are three ammeters, one for each leg of the circuit, and a voltmeter on one of the three sides. These ammeters, of course, are somewhat deceiving to an ordinary attendant, as they indicate wattless current as well as the actual working current, when there is an inductive load such as motors, and it is contemplated to replace them by indicating wattmeters in each lead so that the actual work being done can be seen any time without guesswork.

From the switchboard one set of feeders is run for power and another for lights, each being provided with fuses and a three-pole switch. The lights are turned off at the switchboard during the day. The feeders run to centers of distribution where each branch is fused to the full capacity of the wire. The fuses at the switchboard and distribution centers are the only ones in use. For running from one building to another the wires are bunched together to avoid induction, and run in a single lead covered cable in drain tile, underground.

It is when one reaches the motors that the beautiful simplicity of the multiphase system begins to be most evident. Those in use in this factory are the Westinghouse three-phase constant speed type having no commutators, brushes, collecting rings or moving contacts of any kind. The three leads are connected to the stationary field windings which are placed in slots in the field ring surrounding the armature, and which form the primary coil, while the revolving armature with its winding of copper bars, short circuited at the ends, forms the secondary coil. The field windings being embedded and the armature an indestructible mass of iron and copper, there is nothing about the motor to suffer from neglect, save the bearings, and any mechanic knows how to oil bearings. For gradual starting of a motor an auto-converter is used. It is operated by a double-throw four-pole switch. To start a motor this switch is thrown down until the motor gains a little speed and then is thrown up into running position. The rush of current through these induction motors is so small at the start, however, that Mr. Mack thinks even the auto-converter, as simple as it is, not necessary on motors of less than 20 horse-power. It is the custom in this factory to start all the motors at once at the time the generator is started, which still further adds to the simplicity of the system. With a separately excited alternator this is easily done, while it would be difficult with a self-excited direct current generator. It may be said here that when the two generators are in operation they will be operated in parallel. They can be thrown in parallel at speed or started up together in parallel and the whole factory started with them.

That it is difficult to injure an induction motor goes without saying. These motors are not rated according to heating limit, but according to the point at which the efficiency begins to fall off considerably, which point is somewhat under the heating limit of the primary winding. The point of highest efficiency is between half and full rated load.

In tests to which Mr. Mack has subjected these motors they have started from rest with a torque two and one-half times the full rated load running torque and with 15 per cent. overload has reduced speed 5 per cent.

Another test which was not on the programme was made one day when the box on a new motor got so hot it melted the babbit and let the armature down on the fields. The motor ran this way for some time, in addition to pulling a shop load, before it was discovered. The motor stopped instantly when the current was shut off, and it took hydraulic pressure to get the box off the shaft, but the motor was in operation again in a few hours, and has been running ever since.

There are now in the factory eleven three-phase motors of from 40 to ½ horse-power, running short lengths of shafting in the different scattered departments and freight elevators, and there are 300 incandescent lamps in the shops.

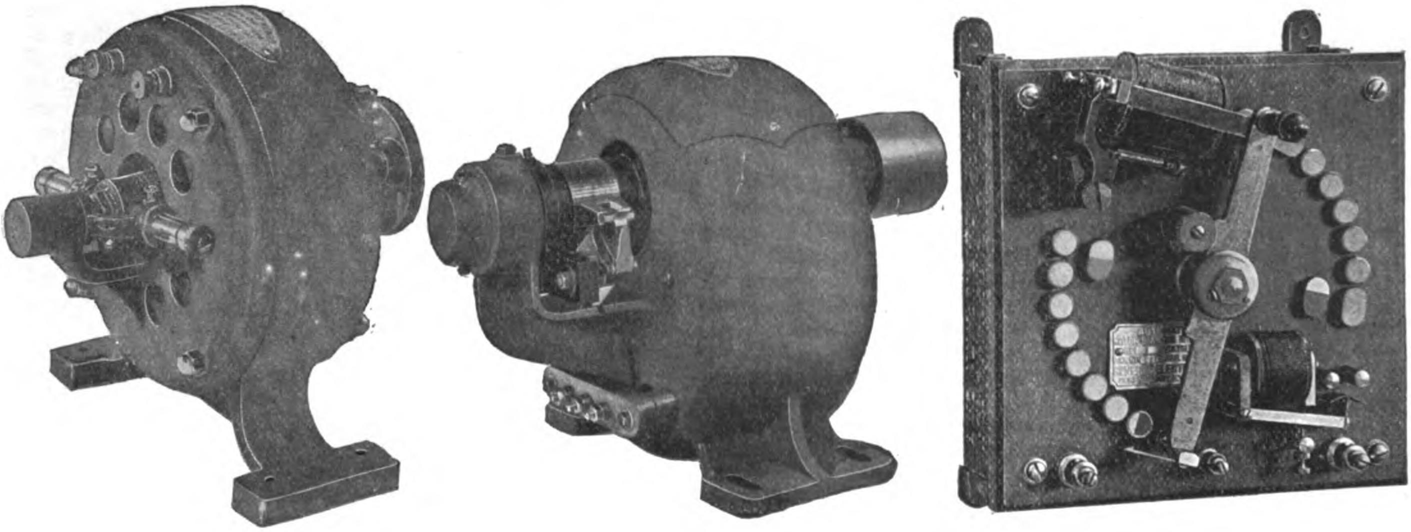
The complete electric driving of the shops will call for six more motors of 50 to 30 horse-power and three more 7½ horse-power elevator motors. Six hundred lights will also be added. The old steam plant will be abandoned for power purposes and used for heating and kiln drying. Power will all be generated in the new power plant in which the 180 kilowatt alternator mentioned is already running.

This plant is but the forerunner of many more of the kind that will go in when the simplicity of the multiphase motor for certain kinds of shop work is more fully appreciated. In fact, a number of similar installations are now under way in the West. The motors in the Kimball factory are most of them bolted to the ceiling out of the way, and practically need no more attention than the shafting to which they are belted. The dust of the shops has no effect on them, and they have no more points of weakness than any machine having two bearings. When this point has been reached in the development of a shop driving motor it is hard to see what further advance can be made in the way of ease of maintenance.

G. E. Direct Current Small Motors.

THE GENERAL ELECTRIC COMPANY announces in a recent bulletin a new line of well designed and thoroughly constructed direct current motors of small capacity adapted to the direct application of power to small machines of all kinds. They have been given the designation of "Type C A," and in their design the production of an efficient motor, sufficiently light and compact to allow of installation in cases where space is limited and absolutely rigid support unobtainable has been kept constantly in view. A magnetic circuit, therefore, entirely of laminated iron has been adopted, and greater lightness and compactness thus secured than would have been possible with cast iron. Furthermore, by the use of laminated iron a uniform magnetic circuit is insured.

High grade material is used exclusively throughout these motors, and the workmanship is the best. The construction of the armature, commutator and field coils follows closely that in the standard General Electric railway motors. Indeed every feature of excellence of the latter has been retained in the "C A" type. The laminated armature core is toothed and wound with the Eickemeyer type of coil. The leads from the armature are soldered directly into slots in the segments and the field coils are thoroughly taped and mounted on laminated pole pieces. The armature can be withdrawn after taking off the pulley end bearing, and the field coils removed through an opening in the frame. In the larger machines the shaft is mounted on two similar swivel bearings each self-oiling. The brush holders are adjustable radially, and may be revolved around the commutator if required. The neutral point is very wide, however, and no adjustment of the brush holder is necessary. These motors are enclosed and thoroughly protected from mechanical injury, but thorough ventilation is provided by holes in the bottom of the case and around the commutator end of the armature. Should these motors be used in places where flying dust necessitates extra protection, the commutator and brush holders may also be encased.



FIGS. 1, 2 AND 3.—G. E. DIRECT CURRENT SMALL MOTORS.

The speeds are lower than usual with motors of small capacity. Better provision for overload is thus given and losses are not so great. The regulation, efficiency and disposition of the material in the "C A" motors also combine to give them a continued high economy. Heating tests show that they will run continuously with but slight increase in temperature, and even with a momentary overload of 100 per cent. little or no sparking is noticeable. In cases where a number of these motors are required to meet special conditions, the standard construction and wiring is susceptible of modification.

No rails are necessary with this motor. The belt is tightened by moving the motor on the lag screws, which pass through elongated holes in the feet of the frame and hold the motor in place.

One feature of advantage which this motor has is the possibility of placing it in almost any position with no greater change than the turning of the bearings to suit the position selected. The "C A" motor may be installed on the floor or be suspended from the ceiling, be set on a shelf or attached to a wall. In every case the oil cellar is at the bottom of the bearing.

The 1 h. p. and ½ h. p. "C A" motors are designed for 115, 230 and 500 volt circuits, the ⅛ h. p. for 115 volt circuits. The floor space for the first named is only 22⅛ inches by 16½ inches, and for the ½ h. p. motor 18¾ inches by 13 inches. The motors are finished in black with brush holders and small parts nickeled and polished.

For use with the two larger sizes a new type of rheostat has been developed. It is provided with an automatic switch which breaks the circuit in case of overload and effectually protects the motor armature. The smaller sizes are series wound and require no rheostat.

Of the accompanying engraving Fig. 1 shows the ½ and 1 h. p. type above described, and Fig. 2 the ⅛ h. p. machine. The rheostat is shown in Fig. 3.

Two Phase Power Transmission Apparatus for St. Joseph, Mo., Stock Yards.

ELECTRICAL power transmission is becoming justly popular around large stock yards and packing houses. Armour & Company, at the Chicago stock yards, began to use electric motors around their plant several years ago, and have been constantly adding to their list of electric motors. The scattered nature of the work in stock yards makes electric power transmission far superior to long lines of steam pipe or shafting.

The two great Western packing firms of Swift & Company and Nelson Morris & Company are building new plants at St. Joseph, Mo., and it is interesting to note that both these plants will be equipped with two-phase alternating lighting and power apparatus.

The generating plant for Swift & Company will comprise one 250 kilowatt and one 800 kilowatt, two-phase, 220 volt, Westinghouse generator. Contracts have also been closed for forty-nine constant speed, two-phase Westinghouse motors of various sizes. The switchboard will be equipped with both wattmeters and ammeters. What few lamps are necessary will be run at 110 volts, the pressure being reduced from 220 volts by a Westinghouse auto-converter. This auto-converter is a converter in which there is no secondary coil, the reduction in pressure from 220 to 110 volts being brought about by connecting the lamp circuit so as to get only half the pressure supplied to the primary coil, or, in other words, so that it gets the effect of only half the number of turns in the coil. The efficiency of the auto-converter is about the same as that of a regular converter with primary and secondary coils. Its advantage is simplicity in construction due to having only one coil instead of two.

Nelson Morris & Company will put in 440-volt two-phase Westinghouse generators, one of 120 kilowatts and another of 50 kilowatts. There will be at first in this plant some twenty two-phase motors of from three to forty horse-power, some of which will be of variable speed and some of constant speed. The switchboard at this plant will also have both wattmeters and ammeters.

Niagara Power In Canada.

A special dispatch from Niagara Falls of February 5 says: The Canadian Niagara Power Company is getting in a quantity of machinery for the purpose of supplying its customers on the Canadian side of the river. This machinery will be placed in the power house of the Niagara Falls Park & River Railway, and it is expected that it will be all installed by the first of May next. Some of it will be made by the Royal Electric Company, of Montreal. The Westinghouse Electric and Manufacturing Company, of Boston, is now building two alternating current generators for the company. They will be completed and put into operation some time in May. When these machines are in operation they will produce 1,000 h. p.

So far the Canadian Niagara Power Company has received no application for power. Advertisements have been inserted in the Toronto and Hamilton papers, but there have been no returns. The company at present is prepared to deliver 500 h. p. to any one applying for power within a radius of four miles of the power house of the railway company, which is situated in the Queen Victoria Park.

Electric Hoists in a Maine Line Quarry.

A NEW design of electric hoist and cable way, manufactured by the Lidgerwood Manufacturing Company, New York, has just been completed at the lime quarry of the S. E. & H. L. Shepherd Co., Rockport, Me. The hoist is equipped with two G. E. 1,200, 500-volt General Electric railway motors, controlled by General Electric K 11 controller. The apparatus is built for lifting a load of ten tons; the average load hoisted is four tons. The power is obtained from the railroad circuit and is sold by the Knox Gas and Electric Company at four cents per horse power. This is considered very much cheaper than steam power as the labor and the wear and tear are reduced to the minimum. The series parallel controller is also a great power-saver. The hoist is capable of hoisting 2,000 casks of lime rock per day. The cable way is 700 feet long and is suspended from two very substantial towers, one 55 feet high and the other, the main hoisting tower, 65 feet high.

This hoisting plant is considered the finest in the country. It is the third plant in Knox County, Maine, that has adopted electricity in preference to steam for hoisting, all using the General Electric 500-volt railway motors with series parallel control.

The Proposed Power Plant at Helena, Mont.

The upper Missouri, or that part of it below Canyon Ferry, has been dry on account of the dam which has just been completed by the Helena Water and Electric Power Company, seventeen miles north of Helena. Although the river at that point runs more than 4,000 cubic feet per second, according to the Government surveys, it took the river two days to raise its level the five feet remaining before it flowed over the dam.

A lake is being formed by the backwater of the dam, which extends seven miles up the river and covers six square miles. Meantime the river below the dam was practically dry, a child being able to ford it without danger. Men prospected in the river bed for gold, while others have taken out large catches of trout and other fish that have been left in the pools formed in the river bed.

The dam is thirty-four feet high and has been built at a cost of $450,000. It is for furnishing electrical power to Helena.

Another Chicago Electric Elevated.

The Chicago City Railway Transit Company, just incorporated for $1,000,000, is an adjunct of the Chicago City Railway Company. It proposes to build an elevated railway in Dearborn street from the river to Thirty-ninth street, at least, which will be a rival to the South Side (Alley) Elevated.

The structure proposed is of the lattice kind, so as not to obstruct the light, as other lines' roads do.

CHICAGO, ILL.—The Electro Medical Manufacturing Company has been formed; capital stock, $2,500; incorporators, C. O. Lindstrom, A. N. Lindstrom and O. B. Hjorth.

LITERATURE

A POCKET DICTIONARY OF ELECTRICAL WORDS, TERMS AND PHRASES. By Edwin J. Houston, Ph.D., New York, 1898. American Technical Book Company. 945 pp. 3½ x 6½ in. Price, cloth, $2.50; leather, gilt edges, $3.

Prof. Houston's dictionary is too well-known to require any extended notice at this late day. It is sufficient to say that it has long enjoyed a well-deserved reputation. In the efforts to bring it up to date, it has been found that the growth of the art and its terminology has been so great that the number of new words, terms and phrase greatly exceeded those in the original dictionary with its appendix. To meet this difficulty and to economize space it was decided to adopt concise definitions and to omit all encyclopedic matter.

The new pocket edition contains no fewer than 11,000 words and 15,000 definitions; this is no mean vocabulary for a comparatively young science, and shows at what rate the coinage of words and terms is going on in the electrical arts.

Being a condensation, and space being valuable, all illustrations have been omitted; this, in our opinion, detracts very little from the value of the work, intended as it is to be an epitome of its larger prototype.

The handy size of this new edition gives it a special value.

ANNUAIRE DE L'OBSERVATOIRE MUNICIPAL DE MONTSOURIS pour l'an 1898. Paris. Gauthiers Villars et Fils. 636 pp. 3½ x 6 in. Paper. Price, $1.

This annual gives the record of the work of the Montsouris Observatory in Paris, which is devoted not only to meteorology, but also to chemistry, micrography and hygiene applications.

FORMULAIRE DE L'ELECTRICIEN. 15th year, 1897. By E. Hospitalier. Paris. Masson & Co. 424 pp. Pocket size. Price, $2.

This excellent compendium continues to increase in value with each succeeding year. It contains some matter not to be found in any other book of its kind that we know, and the careful arrangement adopted as well as the judgment shown in its selection are admirable. We notice a new and valuable feature added to this year's edition consisting of a technical vocabulary giving the principal electrical terms in French, English and German.

NEWS AND NOTES

A Double Commutator Dynamo Supplying a Three-Wire System.

FOR small isolated plants wired for the three-wire system the double-wound, double commutator dynamo is coming into favor as being more efficient, less bulky and cheaper to maintain that two 110-volt machines.

Slack's immense grocery store at 45 Randolph street, Chicago, is now being supplied with light and power from an isolated plant in the basement, which has only one dynamo for supplying the two sides of the three-wire system with which the building is wired. The machine is a Churchward multipolar, built by the Excelsior Electric Co. It has two sets of armature windings on the same core and two commutators, one on each end of the shaft. Each winding generates 110 volts, and the two sides of the machine, that is, the two commutators, are connected in series, running the 220-volt three-wire system just as if there were two separate dynamos. The advantages of the three-wire system are thus obtained without the expense of maintaining and running two smaller machines. The building can be supplied either from the isolated plant or the Edison Company's street mains. The isolated plant is run during times when there is a good load to carry and the balance of the time the building is switched on to the Edison mains.

The dynamo is rated at 250 volts, 400 amperes, and is belted direct to an Allis Corliss engine running 90 revolutions per minute. The fields are compound-wound. An ammeter is kept in one armature circuit and the voltmeter on the board has a double throw switch with which it can be connected to either side of the circuit. The machine runs perfectly sparkless and regulates so well that the running of an elevator does not make any perceptible variation in the lamps.

The store is wired for 2,000 lights, and is one of the most brilliantly illuminated buildings in Chicago. Besides the lights there are three motors in the building, one of 10 horse-power running a freight elevator, one of 8 horse power belted to a shaft driving fans, and one of 10 horse power belted to a shaft from which coffee grinders and the air compressor for the cash carrier system are driven. This latter shaft is usually driven by belt from the engine, and the motor is for use in emergencies and when the engine is not running. Mr. F. D. Mack was consulting engineer for the installation.

Is the Welsbach on the Wane?

Reports reach us from the different manufacturing and illuminating companies of the waning popularity of the Welsbach burner, as proved by the accounts of the illuminating companies in whose territories the mantle burner at first made some headway. Any customers lost are returning to the incandescent lamp, tired of the expense involved in renewing shattered mantles, and worn out with the ghastliness of the light. Additional proof is furnished by the production and sales reports of the different manufacturing companies, which show a constantly increasing demand for incandescent lamps, as well as for arc lamps, especially those of the enclosed arc type. In stores, restaurants, cafes, hotels and halls where the Welsbach burner secured temporary success, the enclosed arc lamp is rapidly bringing back the use of electricity, while in new establishments the Welsbach burner is not finding much foothold.

Electric Shock Given to Speed Race Horses.

According to a New Orleans report, another attempt has been made to use electricity for the speeding of race horses by shockingly appealing to their horse sense. The practice, besides being fraudulent, is certainly unsportsmanlike, and is generally stopped by the exposure and punishment of the offenders. The details of the latest affair are given as follows: Another attempt to use an electric device for nefarious purposes was brought to light yesterday afternoon when an imitation lead pad, containing a battery, was found in the possession of one E. R. Rodgers, owner of Blacking Brush and other platers of that caliber. Secretary Clark had been on the alert for the past week, as there were rumors that a new device in that line was to be sprung on the officials at the Fair grounds. After a diligent search he discovered the lead pad in question in the stable of E. R. Rodgers. The pad was one of the ordinary kind, with mercury cells instead of lead plates in the pockets. There were three batteries on each side, connected with a wire which ran up to the top of the pad, and also with two copper plates which were on the inside at the bottom. When the jockey leaned forward on the saddle over the pad he pressed the button and so turned the current on. An annunciator in one of the pockets of the pad told when the current was on. Several parties were mixed up in the affair and the board of stewards are making a thorough investigation of the matter. Sufficient evidence has been obtained against three of them to warrant the officials in taking action in their cases. There have been several attempts in the past to use devices of this kind, but through the alertness of Secretary Clark they have been nipped in the bud.

A Big New Station For New York.

The Edison Electric Illuminating Company is rumored to have purchased from William L. and Benjamin Peck the block of twenty-two lots bounded by Thirty-eight and Thirty-ninth streets, First avenue, and the East River, New York City, for $345,000. The transaction was negotiated by B. W. Williams, Jr. It is said that the company will erect on the plot the finest and largest electric plant in the country.

BOSTON, MASS.—A bill has been introduced in the Massachusetts Legislature for supervision of telephone rates and service by the Board of Gas and Electric Light Commissioners.

LEGAL NOTES

The Decision as to Joint Use of Tracks.

The first decision in a street railroad case, based on the Kingston, N. Y., traffic decision, was handed down last week by Justice Wilmot M. Smith, in the Supreme Court, in Brooklyn. In the case of Kunz vs. the Brooklyn Heights Railroad Company, the plaintiff sought to enjoin the defendant from making connections with the Nassau Electric Railroad and the Smith street line and operating cars over the tracks of those roads. The contract makes the operation of Brooklyn Heights cars over the other companies' tracks a part of the consideration.

The defendant claims the right to operate its cars over the tracks of the other two companies and the curve without the consent of property owners and local authorities, by virtue of a traffic contract made between the three companies. Justice Smith says that until recently the right to make such contract was considered to be settled. He cites the People vs. Brooklyn, Flatbush and Coney Island Railroad Company, 89 N. Y., 75, and Ingersoll vs. Nassau Railroad, 89 Hun., 213, and says that they are conclusive of the right of the contracting companies to operate their cars over the lines of each other without new consents, unless these decisions were overruled by the decision of the Court of Appeals.

He then examines the case of the Colonial City Traction Company vs. Kingston City Railroad Company, 153 N. Y., 548, and 154 N. Y., 493, better known as the Kingston case. One company sought to condemn the right to use the tracks of another under Section 102 of the Railroad law, in order to connect and make a continuous route. The Court held that the plaintiff had no standing in court until it first obtained the consents of the property owners along the route. "The remark," says Justice Smith, "by the learned Judge who wrote the opinion that the consents of the property owners would be necessary even if the one company consented that the tracks be used by the other company, was obviously a dictum of the Judge, as he himself clearly intimated in writing the opinion upon the motion for a reargument, 154 N. Y., 493."

The opinion concludes as follows: "I therefore conclude that the decisions in the People vs. Brooklyn, Flatbush and Coney Island Railroad Company, 89 N. Y., 75, and Ingersoll vs. Nassau Railroad Company, 89 Hun., 213, have not been overruled, and are binding on this Court."

The Sprague Motor Suspension Patent.

We are in receipt of the following note from the General Electric Company:

The decision in the case of the Sprague Electric Railway and Motor Co. vs. the Union Railway Company and the Walker Company is of considerable importance. As the claims of the Sprague patent have been sustained by the court they cover the mounting of electric motors whose armatures are carried by the field magnet (and not concentrically by the driven axle) by sleeving extensions or arms from the field magnets of the motors upon the driven axle, and flexibly supporting the other end of the field magnet by a spring or flexible connection from the truck or car body.

Sprague's construction simplified the earlier methods of mounting, in which the motors were mounted upon a special supporting frame or platform which was an integral portion of the truck. In Sprague's case the field magnets themselves carry the armature and are directly clamped at one end to the driven axle and spring hung from the truck at the opposite end. The motor became thus for the first time readily detachable, and its mounting much more compact and simple than before.

An injunction has been issued against the Walker Company, and an appeal has been taken from Judge Wheeler's decision, but the court refused to suspend the injunction against the Walker Company, although it allowed the Union Railway Company to continue to run the ten motors it had already in use, but it prohibited them from purchasing any more.

An accounting has also been ordered to be made by both defendants.

National Conduit and Cable Company Wants a Mortgage Made by Eastern Electric Company Set Aside.

The National Conduit and Cable Company, of New York, has instituted suit in the Circuit Court at Baltimore to set aside a mortgage executed by the Eastern Electric Company, of Baltimore, to the United States Trust and Deposit Company, of Baltimore, and to have canceled all bonds issued under the mortgage.

The bill of complaint was filed by Thos. M. Lanahan and Frank Gosnell, attorneys. It states that the mortgage was executed July 15, 1897, and covers all the property and franchises of the Eastern Company. The mortgage, it is alleged, is void, as to the creditors of the company, because the stockholders never authorized its execution.

The whole issue of bonds, it is asserted, were delivered to Wm. I. Atkinson, an employé of the company, who has left the State, and none of them are in the hands of bona fide purchasers for value. Coupons on the bonds are about maturing, and the complainant is apprehensive that they may be paid by the company or its receivers. The claim of the New York company is $5,106.22.

Accident From Furious Speed of a Car in Brooklyn.

William Walsh, in his suit again the Atlantic Avenue Railroad Company, of Brooklyn, stated in his complaint that while he was driving a dirt cart out of a cellar upon a street, he looked to see if any car was coming, and saw none; but that when he was about on the track, a car approached at a furious rate of speed, to avoid which he immediately turned his horses round, and by reason of their perilous position the horses shied, throwing the wagon against the curb and precipitating him from his seat to the ground. Judgment secured by the plaintiff on the trial was affirmed by the Second Appellate Division, which held, by Presiding Justice Goodrich, that plaintiff's evidence that the car struck the hind wheel of his wagon, that his horses went off of their feet, and hit the forward part of the wheel of the wagon against the curb and threw him off, was competent, within the pleadings, upon the question whether the furious rate of speed of the car, coupled with the attempt of the plaintiff to get out of the way, caused the accident. The Court's charge that if the plaintiff looked, and there was no car in sight when he drove into the street, he could not be charged with negligence, was proper, there being a distance of sixty-five feet from the place at which he came upon the street to the corner around which the car came.

Sick Passengers on Cars.

A rule as to sick passengers on street railway cars has recently been laid down by the Appellate Division of the Supreme Court in the Fourth Department, speaking through Mr. Justice Adams. The plaintiff, who was a passenger on one of the Buffalo trolley cars, having paid his fare, took a position on the rear platform. The conductor called his attention to the fact that the rules of the company forbade him to allow passengers to stand there, but the plaintiff insisted upon remaining where he was, because he was suffering from nausea and was afraid he should vomit. Thereupon the conductor ejected the plaintiff from the car, using no more force than was necessary. A majority of the Appellate Division held that the conductor did right as matter of law, but Mr. Justice Green delivered a strong dissenting opinion, in which Judge Hamilton Ward concurred. They thought that the question whether the enforcement of the rule against the plaintiff was reasonable or not was a question of fact to be determined by a jury. "The place selected by the passenger," said Judge Green, "neither annoyed nor inconvenienced any one, and he should have been allowed his temporary purpose of gaining relief from his illness, and avoiding the discomfort which might have resulted to the other passengers had he remained in his seat." In the view of the minority of the court, the act of the conductor was in disregard of decency, humanity, and common civility. It seems to us that the minority forgot the rights of the other passengers, whom the conductor was there to protect, and who have a right to object to travel with men whose drink is too strong for their stomachs.

OBITUARY

John E. Ridall.

We regret to note the death of Mr. John E. Ridall, one of the electric lighting pioneers, of Pittsburg, Pa., who has just been carried off by pneumonia at the age of 48. He started in life a poor boy on the Mississippi river on the "Great Republic," which ran between St. Louis and New Orleans. He soon left the river and entered the Allegheny National Bank at the age of 19. He went from there into the United States Bank, a new organization, of which he was made cashier. In 1880, with Eugene Ingold, he formed the firm of Ridall & Ingold and went into the electric light business as agents of the Brush Electric Company, of Cleveland, for which he was general agent at the time of his death. He was connected with the Allegheny Electric Light Company and had just been re-elected to a directorship in that company. He was elected secretary a few weeks ago of the newly organized Charleroi Brewing Company. He was a member of the St. John's lodge, F. and A. M., and a member of the Duquesne and Americus Republican clubs. He was married in 1872 to Mary B. Love, who has been dead some years. Four sons and one daughter survive.

SOCIETY & CLUB NOTES

New York Electrical Society.—Electricity From Coal.

A very interesting meeting of the New York Electrical Society was held on February 11 at the College of the City of New York, in association with the New York Section of the American Chemical Society. Dr. C. E. Emery presided. An illustrated paper was given by Mr. Joseph Wetzler on "Electricity Direct From Coal," which was discussed by Dr. McMurtrie, Prof. Loeb, Messrs. Essick, Mailloux, Osterberg, and others. About 150 were present, and Secretary Guy announced the names of 19 new members, who were duly elected. It had been hoped to have present Prof. G. F. Barker and Dr. Edgar Smith to discuss some aspects of electro-chemistry, but these gentlemen will appear later before the two societies.

Speeches Over Telephone.

Over the long distance telephone sixty persons who were entertained last week in the United States Hotel, in Boston, by the Electric Club of that city heard speeches delivered by Colonel A. B. Chandler, president of the Postal Telegraph Company, at his home in Clinton avenue, Brooklyn, and Charles P. Bruch, secretary of the Postal Telegraph-Cable Company, in his office in the Postal Telegraph Building. Each of the guests had a receiver placed near him on the table. The experiment was very successful, transmission over the Postal wires being excellent.

Am. Paper & Pulp Association

The annual meeting of the above Association will be held at the Hotel Waldorf-Astoria, February 16 and 17. Among papers to be read are two upon electric power in paper making, by Dr. Louis Bell and Mr. Chas. F. Scott, the latter being chief electrician of the Westinghouse Company. Mr. Clemens Herschel is also to read a paper on "Some Facts in Hydraulics," and Dr. Chas. E. Emery on "The Economic Use of Steam in Paper Making."

Conn. Elec. Lighting Association.

At the annual meeting of the Connecticut Electric Lighting Association officers were elected as follows: President, James English, of New Haven; treasurer, A. M. Young, of Waterbury;

secretary, Addison F. Hunie, of New Haven. After the meeting a dinner was given at Traeger's. Among those present were: James English, of New Haven; A. R. Shepardson, of Waterbury; A. M. Young, of Waterbury; G. G. Blakeslee, of Naugutuck; A. Grannis, of Bridgeport; C. H. Nettleton, of Derby; L. P. Gidding, of New Milford; F. E. Copperthwaite, of Danbury; Prof. C. G. Robbins, of Hartford; A. J. Purrington, of Stamford; M. Crawford, of Stamford; H. L. Mansfield, of Middletown; W. G. Bushnell, and Addison F. Hunie, of New Haven.

E. H. Archibald's Lecture before the Nova Scotian Institute of Science.

We are in receipt of a reprint from the transactions of the Nova Scotian Institute of Science, Vol. IX., Session 1897-98, entitled "On the Calculation of the Conductivity of Aqueous Solutions Containing Potassium and Sodium Sulphates," by E. H. Archibald, B. Sc., Dalhousie College, Halifax, N. S. The pamphlet contains a description of experiments and apparatus and tables on the concentration, dilution, and conductivity of various mixtures.

Remarkably Large Preliminary List of Exhibitors for the May Exhibition.

THE manager of the Electrical Exhibition, Mr. Marcus Nathan, has kindly furnished us with the accompanying preliminary list of exhibitors at the Madison Square Garden, for next May. We understand that between 20,000 and 30,000 square feet has thus already been preoccupied, and that as compared with the Electrical Exhibition two years ago, the applications are five times greater than at the corresponding period, in advance of the event.

Armorite Interior Conduit Co., Pittsburg, Pa.
American Rheostat Co., Milwaukee, Wis.
American Electric Cold Supply Co., Brooklyn, N. Y.
American Pulley Co., Philadelphia, Pa.
American Watchman's Time Detector, 234 Broadway, N. Y.
American Engine Co., Bound Brook, N. J.
Adams-Bagnall Electric Co., Cleveland, Ohio.
Armington & Sims Co., Providence, R. I.
American Electrician Co., New York.
American Elec. & Maintenance Co., 451-453 Greenwich street, N. Y.
American Electrical Works, Providence, R I.
Bullock Electric Co., St. Paul Building, N. Y.
Bossert Elec. Cons. Co., Utica, N. Y.
Baylis Co., The, 99 Cedar street, N. Y.
Bernard, E. G., Troy, N. Y.
Borne, Scrymser Co., 80 South street, N. Y.
Belknap Motor Co., Portland, Me.
Brewster Engineering Co., 27 Thames street, N. Y.
Crocker-Wheeler Electric Co., 39 Cortlandt street, N. Y.
C & C Electric Co., 143 Liberty street, N. Y.
Corey, R. B., 26 Cortlandt street, N. Y.
Coho & Co., H. B., 220 Broadway, N. Y.
Christensen Air Brake Co., Milwaukee, Wis.
Card Electric Co., Mansfield, O.
Cleveland Twist Drill Co., Cleveland, O.
Crouse-Tremaine Carbon Co., Fostoria, O.
Connecticut Telephone & Elec. Co., Meriden, Conn.
Crown Woven Wire Brush Co., Salem, Mass.
Cook's Sons, Adam, 313 West street, N. Y.
Campbell Underground Trolley Co., Towanda, Pa.
Camp Co., H. B., Aultman, O.
De La Vergne Refrig. Co. (Hornsby-Akroyd Oil Engine), N. Y.
Diamond Electric Co., Peoria, Ill.
Diesel Motor Co., of America, 11 Broadway, N. Y.
Edison, Thomas A., Orange, N. J.
Edison Electric Illuminating Co., Duane and Elm streets, N. Y.
Eddy Electric Mfg. Co., Windsor, Conn.
Electric Storage Battery Co., Philadelphia, Pa.
Excelsior Electric Co., Brooklyn, N. Y.
Edison Mfg. Co., Orange, N. J.
Edison, Jr., Thomas A., 96 Broadway, N. Y.
Electrical Engineer, The, New York.
Electrical Review, New York.
Electrical Age Pub. Co., New York.
Electricity Newspaper Co., New York.
Fisher Foundry & Machine Co., Pittsburg, Pa.
Fort Wayne Elec. Corporation, Fort Wayne, Ind.
Fuel Economizer Co., Matteawan, N. Y.
Fostoria Incandescent Lamp Co., Fostoria, Ohio.
Fiberite Co., Mechanicsville, N. Y.
Fairchild & Sumner, 39 Cortlandt street, N. Y.
Gold Car Heating Co., Cliff and Frankfort streets, N. Y.
Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa.
Highland Chemical Co., Connellsville, Pa.
Haines Co., Wm. S., Philadelphia, Pa.
Haring Steam Plant Equip. Co., 26 Cortlandt street, N. Y.
Ideal Electric Corporation, 13th and Hudson streets, N. Y.
Imperial Porcelain Works, Trenton, N. J.
India Rubber & Gutta Percha Insulating Co., Glenwood, N. Y.
Jones & Son, J., 69 Cortlandt street, N. Y.
Johnston Co., W. J., New York.
Keuffel & Esser Co., 127 Fulton street, N. Y.
Kelley & Sons, B. F., 91 Liberty street, N. Y.
Keystone Elec. Instrument Co., Philadelphia, Pa.
Lawrence Machine Co., Lawrence, Mass.
Lewis Tool Co., 44 Barclay street, N. Y.
Lynn Incandescent Lamp Co., Lynn, Mass.
Morris, Elmer P., 15 Cortlandt street, N. Y.
Machado & Roller, 203 Broadway, N. Y.
Mowrey & Co., P. M., 318 Broadway, N. Y.
Niles Tool Works Co., Hamilton, O., and New York.
National Meter Co., 118 Chambers street, N. Y.
Nowotny Electric Co., Cincinnati, Ohio.
National Carbon Co., Cleveland, Ohio.
Nash Gas Engine Co., 99 Cedar street, N. Y.
New Britain Mach. Co., New Britain, Conn.
New York Safety Steam Power Co., 30 Cortlandt street, N. Y.
Oswego Boiler Works, Oswego, N. Y.
Otis Electric Co., 38 Park Row, N. Y.
Onondaga Dynamo Co., Syracuse, N. Y.
Paragon Arc Lamp Co., Boston, Mass.
Peru Electric Mfg. Co., Peru, Ind.
Peckham Motor Truck & Wheel Co., 26 Cortlandt street, N. Y.
Partrick, Carter & Wilkins, Philadelphia, Pa.
Paragon Motor Co., 39 Cortlandt street, N. Y.
Porter & Remsen, 39 Cortlandt street, N. Y.
Roebling's Sons Co., Jno. A., Trenton, N. J.
Safety Insulated Wire & Cable Co., 229 West 28th street, N. Y.
Stephenson Co., Ltd., Jno., 47 East 27th street, N. Y.
Silex Insulation Co., 39 Cortlandt street, N. Y.
Sprague Elec. Co., 20 Broad street, N. Y.
Simonds Mfg. Co., Pittsburg, Pa.
Sinclair, D. J., Caledonia, N. Y.
Street Railway Journal Co., New York.
Translucent Fabric Co., Quincy, Mass.
Thomas & Sons Co., R., East Liverpool, Ohio.
United States Elec. Supply Co., 141 East 25th street, N. Y.
Vacuum Oil Co., Rochester, N. Y.
Van Horne, Burger & Co., Dayton, Ohio.
Worthington, Henry R., New York.
Walker Co., Cleveland, Ohio.
Warren Electric Mfg. Co., Sandusky, Ohio.
Williams & Co., J. H., Brooklyn, N. Y.
Wendell & McDuffie, 26 Cortlandt street, N. Y.
White, J. G., & Co., 29 Broadway, N. Y.
Western Electrician, Chicago and New York.
Weston Electrical Instrument Co., Newark, N. J.
Zimdars & Hunt, 127 5th avenue, N. Y.

REPORTS OF COMPANIES

Bell Telephone Output.

The American Bell Telephone Company made a net increase of 15,820 instruments in licensees' hands under rental for the first month of the fiscal year ended January 20, a record not often exceeded. Comparative figures of telephone movement follow:

January—	1898	1897	1896	1895
Gross output	25,861	14,437	17,620	7,631
Returned	10,041	6,401	7,568	5,945
Net output	15,820	8,036	10,052	1,686
Total outstanding Jan. 20..............	936,513	780,325	685,028	585,352

Kinloch Telephone Co. In St. Louis.

At a meeting of the stockholders of the Kinloch Telephone Company in their offices in the Century Building, St. Louis, recently, a resolution in favor of issuing $1,000,000 in bonds was adopted. There was only one vote cast, and that was by Breckinridge Jones, representing the Mississippi Valley Trust Company, in its capacity as trustee. The issuance of the bonds had been decided upon some time before, and the action was said to be purely formal, but necessary in order to carry out the provisions of the law. In speaking of the bonds, General Manager H. J. Hanford said they had all been subscribed for some time by the directors and stockholders of the company, but that they had not decided when the bonds would be issued, as they had not yet been printed or engraved. Continuing, he said: "The inside wiring into the homes and offices of 3,300 subscribers has been completed, and the work is proceeding at the rate of about 100 a day. We have also 500 telephone instruments up and ready for service, with the exception of a few parts, which might be subject to injury if put on the instruments when they are not in

actual service. We have received 800 more instruments and are having them put together."

ST. LOUIS, MO.—The Imperial Electric Light, Heat and Power Company has a permit for the erection of a two story generating house, at Tenth and St. Charles streets, to cost $40,000.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued February 1, 1898.

Alarms and Signals:—

ELECTRIC FIRE-ALARM CIRCUIT AND SIGNAL BOX. L. G. Rowand, Camden, N. J., 598,160. Filed January 5, 1897. Means to prevent, within certain limits, signals being sent from more than one box at the same time.

ELECTRIC CIRCUIT CONTROLLER. W. T. Budds, Charleston, S. C., 598,358. Filed August 30, 1897. Designed for call box systems, by the use of which a break in the main wires may be located.

FIRE AND BURGLAR ALARM SYSTEM. C. P. Bostian, Milton, Pa., 598,410. Filed April 27, 1897. Details of construction.

Conductors, Conduits and Insulators:—

INSULATING ATTACHMENT FOR ELECTRICAL CONNECTORS. R. P. and J. D. Osgood, Methuen, Mass., 598,109. Filed June 28, 1897. Comprises a rigid jacket of vulcanized fiber made to fit over and around the connnector and accommodate the binding screws.

ELECTRICAL CONDUCTOR. L. C. Werner, Broadbrook, Conn., 598,260. Filed June 15, 1897. Designed for use in connection with the line wires of a signal system in which it is necessary for a vehicle to make traveling contact with a conductor extending along the line.

TERMINAL HEAD FOR ELECTRICAL CONDUCTORS. C. H. Sewall, Chicago, and H. E. Precunier, Oak Park, Ill., 598,328. Filed August 22, 1896. Comprises a metallic case; conducting stems; non-conducting bushings surrounding the stems and extending from the inside to the outside of the case and metallic connectors mounted upon the bushings on the outside of the case.

Dynamos and Motors:

ALTERNATING CURRENT MOTOR. A. Heyland, Frankfort-on-the-Main, Germany, 598,092. Filed December 29, 1896. Method of producing phase difference between the two inducing circuits, consisting in causing one of the circuits to be powerfully affected by the reaction of the secondary member, while reducing the effect of the reaction upon the other circuit.

BRUSH HOLDER. A. J. Oehring, Chicago, Ill., 598,271. Filed June 30, 1896. Combines with the commutator brush, a dog bearing laterally upon it, and a spring actuating the dog to hold the brush securely in position.

Electro-Metallurgy:—

APPARATUS FOR ELECTROLYTICALLY PRODUCING ZINC. C. Hoepfner, Giessen, Germany, 598,180. Filed October 7, 1893. Comprises a vessel containing a zinc-chloride solution, an insoluble anode, and a discoidal revolvable cathode dipping partly into the solution, and means for preventing chlorine bubbles forming at the anode.

APPARATUS FOR ELECTRODEPOSITION OF GOLD AND SILVER. E. Andreoli, London, England, 598,193. Filed October 1, 1895. Employs anodes of peroxidized lead acting in the presence of and in combination with a cyanid or cyanid-compound solution.

ELECTRODEPOSITION OF LEAD. E. P. Clark, New York, 598,313. Filed June 8, 1897. Consists in first partially changing an acetate-of-lead solution into an acetate-of-zinc solution and then depositing lead electrolytically.

Lamps and Appurtenances:—

ELECTRIC LAMP FOR BICYCLES. P. A. Dowd, Boston, Mass., 598,198. Filed July 10 1897. The lamp is supplied with current from a generator driven by contact with the tire of the front wheel.

ADJUSTABLE SUPPORT FOR INCANDESCENT LAMPS. W. J. Going, Amsterdam, N. Y., 598,218. Filed May 26, 1897. A bracket having a hemispherical cavity, a ring swiveled on the outer edge of the bracket, a part extending between and journaled in diametrically opposite sides of the ring, and a rod threaded on one end and extending through the part and adapted to bear upon the wall of the cavity.

SUPPORT FOR INCANDESCENT LAMPS. W. J. Going, Amsterdam, N. Y., 598,219. Filed July 21, 1897. Similar to above.

SUPPORT FOR INCANDESCENT LAMPS. W. J. Going, Amsterdam, N. Y., 598,220. Filed July 21, 1897. Similar to above.

SUPPORT FOR INCANDESCENT LAMPS. W. J. Going, Amsterdam, N. Y., 598,221. Filed July 21, 1897. Similar to above.

Measurement:

ELECTRIC METER. C. D. Raab, Kaiserslautern, Germany, 598,208. Filed December 30, 1896. Motor wattmeter for alternating currents. Provided with one or more metallic rotary armatures acted upon by two sets of magnetic fields.

ELECTRIC METER. C. D. Raab, Kaiserslautern, Germany, 598,209. Filed June 24, 1897. A motor wattmeter for alternating currents having a rotary armature without current supply, and a coreless solenoid, in combination with two coreless shunt field coils of like polarity so arranged as to form a common magnetic field.

Miscellaneous:—

ELECTRIC CONTROL DEVICE FOR ELEVATORS. J. D. Ihlder, Yonkers, N. Y., 598,097. Filed April 18, 1896. Employs a control-motor, and an electro-magnetic clutch, the clutch being provided with teeth.

INSTRUMENT WINDING DEVICE. A. J. Oehring, Chicago, Ill., 598,272. Filed October 12, 1896. See description on page 164, Feb. 10.

INSTRUMENT WINDING DEVICE. A. J. Oehring, Chicago, Ill., 598,273. Filed November 28, 1896. Similar to above.

ELECTRIC HEATER. E. E. Cruzen, Baltimore, Md., 598,303. Filed August 7, 1897. An electric heater for drying canals in the roots of teeth.

AUTOMOBILE VEHICLE. W. A. Crowdus, Chicago, Ill., 598,314. Filed October 9, 1896. Embodies an automatic clutch for picking up the load after the motor is energized.

ELECTRIC GAS LIGHTING APPARATUS. C. Eickmann, Indianapolis, Ind., 598,316. Filed July 3, 1897. Consists mainly in a vessel in which ignition and explosion take place to ignite the gas escaping from the burner.

ELECTRIC FURNACE. J. E. Hewes, Philadelphia, Pa., 598,318. Filed April 27, 1897. Designed for the production of calcium carbide by the incandescent process.

ELECTRIC CIGAR LIGHTER. W. F. Kessler, Auburn, Ind., 598,489. Filed July 22, 1897. Details of construction.

Railways and Appliances:—

STATION INDICATOR. D. C. and J. M. Jones, St. John, Ky., 598,009. Filed March 26, 1897. Employs a magnet and an armature to primarily operate the escapement lever of a spring actuated mechanism.

CONDUCTOR FOR ELECTRIC RAILWAYS. G. Ritter, Stuttgart, Germany, 598,184. Filed October 16, 1896. Three-wire system of distribution for railways.

MECHANISM FOR STARTING, STOPPING AND CONTROLLING SPEED OF MOTORS OF ELECTRIC CARS. F. H. Foster, Brooklyn, N. Y., 598,199. Filed August 12, 1897. Means to control the entire number of cars from any platform.

Switches, Cut-Outs, Etc.:—

FUSIBLE CUT-OUT. E. A. Lowe, North Plainfield, N. J., 598,106. Filed March 5, 1897. The terminal wires are screw-threaded and held permanently within a box of insulating material and the fuse is held by spring clips connected to the terminal.

Telephones:—

TELEPHONE SYSTEM. C. A. Barron, R. T. Reid and J. L. McDonnell, Tacoma, Washington, 598,172. Filed April 5, 1897. "Party line" system.

TELEPHONE SYSTEM. R. T. Reid and J. L. McDonnell, Tacoma, Wash., 598,183. Filed May 7, 1897. Means to prevent a subscriber on a party line from "cutting in" while the line is in use.

POLARIZED SIGNAL BELL. F. R. McBerty, Downer's Grove, Ill., 598,269. Filed November 24, 1896. Signal bell for telephone substations. Details of construction.

SELF RESTORING ANNUNCIATOR. J. Steiner, Brooklyn, N. Y., 598,276. Filed May 23, 1896. Adapted for telephone boards. Details of construction.

TELEPHONE APPARATUS. F. B. Cook, Chicago, Ill., 598,285. Filed March 25, 1895. Means to obviate "noise" in unbalanced circuits.

PERSONAL

MR. R. R. BOWKER, first vice-president of the New York Edison Company, left for Europe last Saturday to obtain a much needed rest.

MR. L. A. FERGUSON, electrical engineer of the Chicago Edison Company, left for Europe on the "Teutonic" on Wednesday last, for a trip of four or five weeks.

MR. HERBERT LLOYD, general manager of the Electric Storage Battery Company, has been elected a director of the company. We congratulate Mr. Lloyd on this recognition of the faithful services rendered by him to the company.

THOS. A. EDISON is the subject of an interesting illustrated interview in that admirable new publication "Success." There are several views of Mr. Edison in his characteristic attitudes, and the article is full of good notes. Mr. Edison, by the way, was 51 last Friday, and looks hale enough to live midway into the next century. Mr. Edison has recently protested in the papers against the use of his name as author in connection with a fiction about attacking the planet Mars.

MR. HERBERT A. WAGNER, E. E., of the Wagner Elec. Mfg. Co., of St. Louis, Mo., was a welcome visitor to New York last week.

THE STOCK MARKET

Many Favorable Conditions.

There are various signs of improving business, but the most important have been the buoyancy of the iron and steel market, and the higher price for cotton; indeed, the general level of prices has continued excellent. As for the railways, they are doing splendidly, and January was the best month, excepting only November, since the panic of 1893. Out of 112 systems, no fewer than 102 report gains. Bank clearings for last week show a gain of 52 per cent. over the same week in 1897, and actually 82 per cent. more than the corresponding week in 1894.

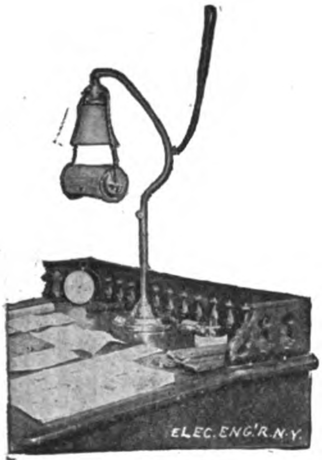
Business failures for the week were 278 as compared with 381 for the week in 1896.

What electricity can do for local traction is shown in the phenomenal advance of New York Metropolitan since its extensive adoption of the conduit system. Even within the past week on sales of 91,000 shares it has gone from 149 to 169. The sales of Western Union were 16,606 shares around 92. Of General Electric, 39,793 shares were sold around 38 and 39. It is rumored that the coming annual report will show 5 per cent. earned on the common stock. New York Edison is firm on small sales at 134, and Brooklyn Edison is rising steadily, being now 112. In Boston, Bell Telephone is up to 270.

Copper, New York, is 11 cents. Heavy steel rails, Eastern mill, are $18 per ton.

TRADE NOTES & NOVELTIES

The "Eureka" Desk Lamp.



A VERY unique and useful desk lamp for business men, banks, students, and the home has been patented by Mr. W. H. Sheppard and is called the "Eureka desk lamp." It is unsurpassed for convenience of operation and is a perfect safeguard for the eyes, being especially helpful to those who are compelled to do a great deal of reading and writing by artificial light. As will be seen from the figure, the apparatus consists of a bracket supporting an ordinary drop light and a cylindrical, carefully shaded desk lamp. By means of a switch in the socket of the lamp, four combinations are possible. By giving the key a quarter turn the lamp in the cylinder is switched in, as used for reading or writing purposes. In case visitors call, by another quarter turn of the key in the same direction, the upper lamp lights up the office. Should it be desired to conceal the writing or papers on the desk from the visitor, another quarter turn of the switch will extinguish the lamp in the cylinder, and the cylinder itself acts as a shade between the upper light and the desk. In case more light is desired on the desk, the cylindrical shade can be swung back and both lamps can be used for desk illumination. The lamp can be raised or lowered to suit the convenience of the person using it. It can also be attached to a combination or plain wall bracket or be attached to brass tubing fastened to the ceiling. For banks and offices where much writing is done, these ingenious devices are invaluable, as every business man will affirm that his eyesight is worth more to him than the price of a perfect desk lamp. The patent is for sale outright or on royalty by Mr. W. H. Sheppard, 235 West 125th street, New York.

New Trolley Cars For the New York Metropolitan Co.

The Metropolitan Street Railway Company has taken steps to provide new cars. President Vreeland a few days ago signed a contract with the Brill Company, of Philadelphia, for the purchase of 500 cars of the most improved construction. The cost of the cars will be nearly $900,000. Most of them are to be delivered early in April and the others as soon thereafter as practicable.

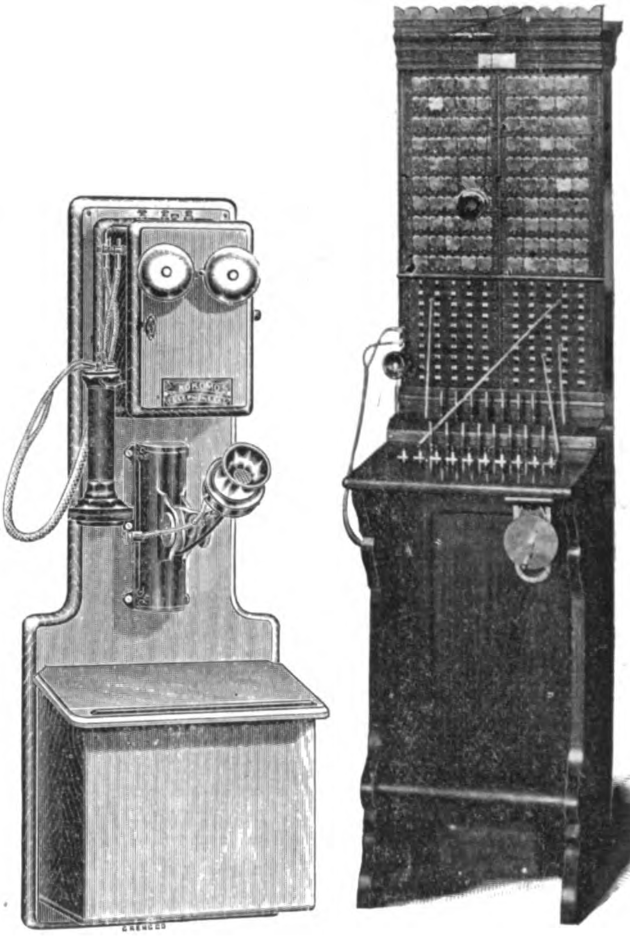
"Just as soon as we know that winter is behind us," said President Vreeland last week, "we shall go ahead and complete the work of construction on all our conduit lines."

The lines referred to are those in First avenue, Second avenue, Sixth avenue, Amsterdam avenue, Eighth avenue, Tenth avenue, Twenty-third street, and several other cross streets. Much of the work on some of these lines has already been done. That in Eighth avenue has so far advanced that it is hoped to run electric cars from the Astor House to the end of the line by the 1st of May.

The Metropolitan Company, since an agreement with the Third Avenue Company has been effected, does not look for any further opposition to the laying of conduits in Park Row from Centre street to Broadway.

The Kokomo Telephone Apparatus.

THE Kokomo Telephone and Electric Manufacturing Company, of Kokomo, Ind., are reporting an increased business in their high grade telephone apparatus and have just installed several large outfits in telephone exchanges. Their microphone transmitter is guaranteed against packing and has stood the most severe tests. Their exchange telephones will stand hard service, have a neat appearance and are built for use on long and short



KOKOMO TELEPHONE APPARATUS.

lines; one of these sets is shown in the figure. The new switchboard which this enterprising company has just placed on the market seems to fill the requirements of a substantial and practical board. The cut shows a 100 number board, which is 5 feet 6 inches high and 12 inches wide. The Mayer drop is used in the construction of this board, this being claimed to be the smallest and most perfect drop in the market. A very commendable feature of the operation of this board is the fact that the operator in ringing up a subscriber does not ring back in the ear of the subscriber who has called up the exchange. The number of operations has been decreased from five to four to connect two subscribers. It is claimed that the Kokomo switchboard has less cross talk than any other telephone switchboard on the market.

Besides the above, the company manufacture lightning arresters, cross connecting boards, receivers, induction coils, bells, batteries, magnetos, etc., and are in a position to fit out an entire exchange with their own standard apparatus. The company have received many flattering testimonials from persons using their apparatus and every exchange they have furnished and every telephone they have sold stands as a reference of the superior merits of their goods.

The Keystone Arc Light Voltmeter and Ground Detector.

THE Keystone arc light voltmeter and ground detector, manufactured by the Keystone Electrical Instrument Co., Philadelphia, Pa., combines in one instrument: A voltmeter which will indicate the actual voltage of each circuit, or the total voltage of the generator, and consequently the number of lamps burning, and a ground detector which will indicate a ground, determine its character and location. It will indicate the character of the ground, its resistance, and its location on the lines by taking three readings and equating them in simple formulæ. It can be used when the circuit is "alive" thus giving results under working conditions. It replaces a cable testing set which has proved extremely unsatisfactory owing to the many microphone contacts in circuit. It is self-contained, well made, accurate, reliable, dead-beat, unaffected by external fields or changes in temperature, easy and safe to manipulate, and low in price. In connection with a set of switches and a battery of cells, or an ordinary incandescent circuit, it can be used to test the continuity of the line and the resistance from line to earth,

KEYSTONE ARC LIGHT VOLTMETER AND GROUND DETECTOR.

during the day, and for this purpose will be found much easier to handle, more accurate in results and quicker in action than any galvanometer and bridge method.

An idea of the general appearance of the instrument may be obtained from the cut, and, in further explanation, we would say that it consists of a compound galvanometer system, mounted in a case which effectually shields the instrument from the influence of external fields. This case is finished in oxidized copper, well lacquered, and presents an attractive appearance. The scale is practically uniform from zero to maximum reading, indications are dead-beat, and the temperature co-efficient of the wire employed is so small that external changes of temperature make no difference in indications.

Packard Transformer, Model 1898.

The New York and Ohio Company, of Warren, Ohio, well known as makers of the Packard lamps and transformers, have for some time past been developing a new series of transformers which are now ready for the market. These will be known as the Packard Model '98. The New York and Ohio Company claim that these transformers are fully equal and in some respects superior to any in commercial use. Particular claims are made regarding regulation, a point in transformer design which in the endeavor to obtain an exceedingly low core loss, has been too often considered of secondary importance. The New York and Ohio Company have secured the services of Mr. H. W. Wiswell, who for several years has been connected with the transformer department of the General Electric Company. Mr. Wiswell's experience in this particular branch fits him admirably for his new duties. The New York office has been established at No. 1 Broadway under the personal supervision of Mr. J. W. Peale, president of the company, who, assisted by an efficient force, will handle the Eastern business.

Large Orders For Walker Apparatus.

The Standard Light and Power Company, of Dallas, Texas, has placed an order with the Walker Company for two alternators, one of 225 and the other of 325 k. w. capacity. They are to be direct connected to "Erie" engines and are designed to run at 125 revolutions per minute. The current will be two-phase and 60 cycles. In addition to these the Walker Company will furnish them with two direct connected railway generators of 225 and 325 k. w. capacity, respectively.

Two alternating generators of 250 k. w. capacity each are being built for the North River Electric Light and Power Company, of New York City. They are to be of the belted type.

Townsend, Reed & Company, of St. Louis, have purchased for the St. Louis, Belleville and Suburban Electric Railway two 200 k. w. direct connected Walker railway generators, besides eight double 10-S railway equipments with "S" controllers.

On the other side of the Atlantic the Glasgow Municipal Tramway will place a number of Walker motors on its cars at an early date, while the Electric Railway, of Alexandria, Egypt, will increase its present Walker plant by the addition of one 150 k. w. belted generator with switchboard, and four double 3-N equipments.

Weston Electric Appliance Co.

The announcement is made of the formation of the Weston Electric Appliance Company, with a capital stock of $750,000. The incorporators are Edward Weston, of Newark, N. J.; F. O. Matthiesen, of New York, and H. E. Neise, of Jersey City. It is stated that the concern will build a large new factory on ground already purchased near Waverley, N. J.

"Gold Standard" Electric Heaters for the South Side Elevated Railroad, Chicago.

The equipment of the South Side Elevated Railroad, of Chicago, with electric power is rapidly nearing completion. The Sprague Electric Company's system of propulsion of cars and trains on this road has already proven its merit and given general satisfaction. During the past winter the railroad officials sought to determine the advisability of equipping their cars with electric heaters, and in order to satisfy themselves that the adoption of electric heaters would be to their advantage and at the same time find out which heater of the many offered was the most suitable for the purpose, the South Side Road had some very careful and extensive tests made of the heaters of five of the most prominent electric heating companies in this country.

Each of these companies was given the privilege of equipping a car and the five cars thus equipped were run during the past winter. The result was that the contract was awarded to the Gold Car Heating Company, of New York and Chicago. The car which the Gold Company equipped was supplied with twenty-four of the improved "Gold Standard" electric heaters. The heaters were wired to permit of six graduations of temperature, which was controlled with a regulating switch. The car was comfortably heated in the coldest weather and the regulation of the temperature to suit the outside conditions was entirely satisfactory. With the "Gold Standard" electric heaters a perfect uniformity of the temperature was maintained at all times in all parts of the car.

This contract covers the entire equipment of the South Side Elevated Railroad and calls for about three thousand electric heaters. This is one of the largest orders ever placed for electric heaters and the Gold Car Heating Company have reason to feel proud of their success.

Carbons For Enclosed Arc Lamps.

Cored carbons and solid carbons for enclosed arc lamps, manufactured by the Washington Carbon Company, of Pittsburg, Pa., are now attracting a great deal of attention. Their goods are held to be equal to any on the market; the consequence is this company's business is considerably on the increase and consumers are supplied in any quantity, even though it may be necessary "to break packages." This company caters to small and large trade and is prepared to ship on a moment's notice.

A New Plant for the Boston Electric Light Co.

The Boston Electric Light Company has concluded a contract with the General Electric Company for the equipment of its great generating station now in course of erection. Up to the present the Boston Electric Light Company has operated a number of stations throughout Boston. Two of these, however, have recently been abandoned to make way for the new railroad stations now being built and the company has, therefore, decided to consolidate all the small stations into one mammoth generating plant to be erected in South Boston.

The system will involve the use of the three-phase alternating current, selected on account of its greater flexibility and the fact that by its use the value of the present distributing system will not be diminished. The dynamos will be four in number each of 1,500 k. w. with a reserve capacity of 50 per cent., giving a total output of 12,000 h. p. They will be of the revolving field type, to permit a high voltage to be taken directly from the dynamo to the wires without the use of transformers to increase the pressure. The revolving field on each dynamo will be mounted on the shaft of an engine, and the voltages of the generated current will be 2,200 volts. To excite these dynamos, two smaller ones each of 100 h. p. will each be driven by a synchronous motor. In addition, eighteen large synchronous motors each of 200 h. p. will drive thirty-six arc lighting machines. Each motor will be set between two Brush 125 light arc dynamos, the shaft of the motor armature being extended to become the shaft of the armature of the arc dynamos. The power transmission for this arc lighting plant, therefore, will be confined to the width of the dynamo room. If this system were not employed small engines would have to be used, whereas by the method selected only the large main engines will be employed.

For the power circuits, that is for the stationary motors, two rotary converters each of 500 k. w. or 650 h. p. are included in the contract. These will take the three-phase alternating current and convert it into direct current at about 550 volts. For the incandescent lighting system, the three-phase current wires will simply be connected to the existing net work, using the transformers now in use.

Large Orders for Chloride Accumulators.

The very extensive application of chloride accumulators, manufactured by the Electric Storage Battery Company, of Philadelphia, is indicated by the large business being done by the company. The latest contracts cover batteries to be used in connection with electric elevators in the 30-story office building being erected on Park Row, New York, where 58 chloride accumulators of 3,500 ampere hour capacity will be installed; for the Cushman Building, New York, 118 320 ampere hour cells; the Dun Building, New York, 114 1,100 ampere hour cells. The State Mutual Life Assurance Building, Worcester, Mass., have contracted for an increase in their original plant. Very large plants are being constructed for the Chicago Edison Co. and the Buffalo Railway Co. Chloride accumulators are being installed in the residences of Mr. Jno. I. Waterbury, Morristown, N. J., and Mr. G. P. Morosini, Riverdale, New York. Also in Mr. Howard Gould's new steam yacht, Niagara, and Mr. Lloyd Phoenix's yacht, Intrepid. The American Fire Insurance Co.'s building in Philadelphia is being equipped with a battery for night lighting. The Germantown, Pa., Hospital, which has operated a battery of chloride accumulators for about two years, is increasing the capacity of its plant by 50 per cent.; 108 cells, ranging in capacity from 400 ampere hours to 1,200 ampere hours, have been furnished to the Cleveland Telephone Co., and the Southern Bell Telephone Co.; 1,300 cells have been supplied for fire alarm work at Portland, Oregon; Augusta, Ga., and St. Paul, Minn. For telegraph work the Lehigh Valley Railroad Co. has ordered 208 cells; the Southern Pipe Line Co., 50 cells; the Great Northwestern Telegraph Co., 265 cells; the C. M. & St. P. Ry. Co., 276 cells, and the Postal Telegraph & Cable Co., 220 cells. The General Electric Co. have contracted for 112 cells of from 160 to 200 ampere hours' capacity; the Patton Motor Co. and the National Electric Car Lighting Co. are installing 432 cells in conection with their systems, and the State School of Mines, Colorado, has equipped its laboratory with 52 cells of 160 ampere hours capacity.

CHICAGO proposes to cut down a lot of overhead wires if they are not removed by March 1.

United States Electric Plants For Malaga, Spain.

United States Consul Bartleman, of Malaga, Spain, transmits a newspaper extract which states that two companies have sprung into existence there to supply the demand for electric lighting. With a population of about 125,000, inhabiting some 20,000 to 25,000 houses or flats, adds the article, it is evident that there is ample room for two works. The great demand for electricity, however, has rendered essential the erection of further generating plant, and, as the engineering strike in England has prevented the completion of English-made machines, the directors have had to place their orders in other quarters. They have arranged with the Westinghouse Electric Company, of Pittsburg, to supply immediately two sets of plants, each of 135 k. w. capacity, and these are now on the way to Malaga and will be erected early in the new year. The total capacity will thus be raised to 765 k. w., and, in addition to this, we understand that the directors have under consideration the consulting engineer's estimates for two further sets of plant, each of which is to be of 300 k. w. capacity. After the works had been in operation for less than two months, upwards of 800 consumers had applied for a supply of electricity, and that 7,200 lamps were then connected to the mains. On the day when the supply was started, the maximum load was 16 k. w., and the output for the day only 29 units, but by November 30, the load had reached 128 k. w., and the output for the day had advanced to 884 units, while on December 11, 148 k. w. was recorded as the highest load and 1,093 units as the day's output.

Siemens & Halske Work in New England.

The Siemens & Halske Electric Company of America have just obtained, through Mr. H. C. Spaulding, their New England representative, the contract for the new municipal lighting plant at South Norwalk, Conn. This plant will be of special interest as it will be run on a straight 220 volt two-wire system for arc and incandescent lights as well as power. While a number of these stations have been put in abroad, there have been comparatively few installations of the kind here, except for isolated plants.

The New England business of the Siemens & Halske Company has been very largely increased during the past year, one of the most notable contracts being one for the Boston City Hospital plant, which is considered one of the finest of the kind in the country. Another plant is being installed in the new theatre at Springfield, Mass., in which lights for the entire edifice as well as some adjoining buildings will be furnished from two 75 k. w. machines running at 100 r. p. m. Among other large installations lately completed may be mentioned the plant in the Academy of Music, Fall River, Mass., and one in a large manufacturing concern, where current is furnished by two machines of 400 k. w. capacity. The generators in all the above mentioned plants are of the standard Siemens & Halske external armature type, while a large number of internal armature belted machines in both the slow and moderate speed types for lighting and power service have been installed in Boston and vicinity during the past few months.

A Big G. E. Railway Generator For Louisville, Ky.

The largest generator for electric traction work ever built is now under construction at the works of the General Electric Company at Schenectady, N. Y. When finished it will be installed at the Logan street station of the Louisville Railway Company, Louisville, Ky. On account of its large diameter the armature of this generator cannot be transported over the railroads in its completed state, either erect or on its side. The generator will, therefore, be assembled in Louisville. The completed machine will have 22 poles, an output of 2,400 kilowatts or 3,000 horse-power, and will be driven at a speed of 75 revolutions per minute by a 4,000 horse-power, cross-compound engine to be furnished by the Allis Company.

The generator will be constructed to stand an overload of about one-third, so that the capacity in case of emergencies may equal 3,200 kilowatts or over 4,000 horse-power. The principal dimensions of the machine will be as follows: Diameter of field frame, 19 ft. 0 in.; width of field frame, 4 ft. 1 in.; diameter of armature, 12 ft. 9 in.; diameter of commutator, 9 ft. 3 in.; diameter of shaft, 2 ft. 3 in.; total weight of armature and commutator, 83,000 pounds; width of armature, 5 ft. 0 in.; width of commutator, 21 in.; total width of generator, 77 in.

The total weight of generator complete is 174,000 pounds.

Previous to the manufacture of this machine the largest generators constructed for electric railway work were those of 1,600 kilowatts or about 2,500 horse-power, the first of which was used in the Intramural Power House at the World's Fair.

Dynamos of the same enormous output have since been installed in Philadelphia, Boston and Chicago. Four are also operating in the Kent avenue power station of the Brooklyn City Railroad.

CATALOGUES.

THE BROWN & SHARPE MANUFACTURING COMPANY, of Providence, R. I., have just issued a new edition of their general catalogue of machinery and tools. The catalogue has been thoroughly revised and contains 437 pages—20 more than the preceding one. The large number of tables it contains make it especially valuable to the workman as a book of reference. These catalogues are mailed, on application, to any address without charge, or are furnished by the hardware and supply dealers.

HARVEY HUBBELL, 33-35 Organ street, Bridgeport, Conn., manufacturer of machinery, tools and brass machine screws, has issued a very handsome catalogue illustrating the various types of apparatus he manufactures. The typography of the catalogue is highly commendable, and the general arrangement and the description of his machinery certainly do justice to the high grade work turned out by the establishment.

THORPE, PLATT & COMPANY, 97-103 Cedar street, New York, are sending out catalogues descriptive of their standard high pressure fittings and flanges. The book contains a description of special fittings and gives tables showing the sizes of flanges for 750 and 1,500 pounds pressure per square inch. The second part of the book contains information for use in designing hydraulic plants, which is of considerable value to those who have to design and use hydraulic machinery. The information on riveting, forging and flanging has been worked up from experiments made in the shops. The formula for flanging dies, by T. R. Browne, will be found of considerable value to all manufacturers using flanging presses. The book contains a very complete index.

THE STOW MANUFACTURING COMPANY, Binghamton, N. Y., have issued a very handsome and complete catalogue illustrating the numerous uses to which the Stow flexible shafts have been put. Among these may be mentioned wood carving, cloth cutting, metal polishing, sand papering, stone drilling and polishing, boring, flue cleaning, multiple and mining drills, dental engines, surgical instruments, die work, and many others. The catalogue calls attention to their ironclad electric motor, which is practically dust and water-proof. All their machinery is made on the interchangeable system and the flexible shaft can be used in connection with any tool.

GENERAL ELECTRIC COMPANY, in view of the large number of applications made for information, which is embodied in the second part of its recently issued Edison incandescent lamp catalogue, have published this information in a separate 16 page pamphlet of small octavo form. This information is of value to all users of incandescent lamps and the General Electric Company will be pleased to supply copies of the pamphlet.

ELMER P. MORRIS, manufacturers' agent for electrical material and other specialties, 15 Cortlandt street, has issued a very handsome and useful catalogue giving details of all the goods handled by him. It runs a length of over 100 pages, well illustrated, prices, etc.

PIERCE & MILLER ENGINEERING COMPANY.—In the article describing the new work of the Brooklyn Edison Company, in our issue of January 6, we omitted to mention that the large 3,000 h. p. triple expansion McIntosh-Seymour engine was contracted for by the Pierce & Miller Engineering Company, of New York. The engine is now undergoing a test.

NEW YORK NOTES.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., manufacture a full line of sheet metal machinery, and during the last two years they have paid a good deal of attention to special presses for electrical work. They have recently supplied two of their large double-crank presses to the General Electric Company, of Schenectady, and four of the same style of presses to the Westinghouse Company, of Pittsburg. These have proved very desirable for cutting out large armature discs. They are heavy and built in the most careful manner, and with a number of improvements in the adjustments and arrangements of long strokes, etc., which are highly appreciated by the superintendents of the factories named. They are also building some new forms of machines for notching armature discs. They have recently issued a large circular illustrating their various presses, which they are mailing to all parts of the world.

EUGENE MUNSELL & COMPANY, of New York and Chicago, importers and dealers in amber "Mica" report a very gratifying demand for all their insulating specialties. The India "Mica" is being used very largely by electrical manufacturers and street railway companies both in this country and in Europe, on account of its being free from iron as well as its high insulating qualities.

THE OTTO ELECTRIC CO., 148 Times Building, New York, inform us that they have secured the rights and sole agency for the U. S. and Canada of the Cox thermo-electric generators. Their intentions are to manufacture the generators in this country and push the sale vigorously.

S. R. JONAP & COMPANY, Eighth avenue and Twenty-fourth street, New York City, have just installed a large number of standard Bergmann enclosed arc lamps, made by the General Incandescent Arc Light Company. They report having tried another make for some time, but have now changed over, as noted.

A. WIRSCHING & SONS, manufacturing electricians, have removed their office and factory to 61 and 63 Duane street, corner of Elm, New York City, where they will be glad to hear from old and new patrons.

THE EDISON MANUFACTURING COMPANY, 23rd street, New York, report that their business in Edison LaLande batteries has very largely increased during the last year, especially among railroads, which use these batteries for signal work and also among gas engine manufacturers, who use these batteries very largely for igniting purposes. They are bringing out a range of batteries with steel cells, which are so constructed that they will be absolutely liquid tight. These batteries are chiefly suitable for gasoline, launch and traction work and also for motor carriages. They also report considerable increase in business in electro-medical apparatus, including X-ray equipments, cautery transformers for the direct and alternating current and electrical centrifuges to run on the 110 volt direct, alternating and battery current.

THE ROBB CONDUIT AND UNDERGROUND ELECTRIC SYSTEM COMPANY, of New York City, has been formed; capital stock, $25,000. Directors: F. D. Robb and Dr. G. E. Crittendon, Hot Springs, Ark.; Fritz Andraea and Gertrude Hanbury, New York City; A. L. Wear, Cornwall.

NEW ENGLAND NOTES

THE BOSTON GAS LIGHT COMPANY are erecting a new gas plant at Commercial Point, in the vicinity of Boston. This new plant consists of a building about 52 feet wide and 185 feet long, having brick side walls and brick partition walls dividing the building into three distinct parts, made up of a generator house, blower room, and condenser room. No wood is used in the construction of the building, and it is absolutely fireproof. The floors are of steel throughout. The roof is covered with slate supported on steel roof trusses and framing. The contract for furnishing and erecting the steel roof work complete has been let to the Berlin Iron Bridge Company, of East Berlin, Conn.

WESTERN NOTES

WESTERN ELECTRIC COMPANY has placed in stock a large supply of Victor split insulators. This insulator makes a very effectual break insulator for overhead line wires and for guy wires.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., manufacturers of live steam feed water purifiers and exhaust steam feed water heaters, report several large orders recently received through their Philadelphia office from the following concerns: The New York Sugar Refining Company, Long Island City, N. Y., three special live steam feed water purifiers aggregating 3,750 h. p. Also from the same company, three exhaust steam feed water heaters of 4,500 h. p. capacity. The Union Traction Company, Philadelphia, Pa., 3,000 h. p. live steam feed water purifiers, special for high pressure. The Springfield office also report sales to the Deering Harvester Company, Chicago, Ill., for 2,500 h. p. live steam feed water purifiers; a repeat order from the Proctor & Gamble Company, Ivorydale, O., for a 1,000 h. p. purifier; Louis Sands, Manistee, Mich., 1,000 h. p. purifier; and Thomas & Smith for Chicago Public Library, four special live steam feed water purifiers of 300 h. p. each.

THE NEW EXTRA B. B. IRON BOX BELL, introduced and handled by the Central Electric Company, of Chicago, has proven to be one of the best sellers ever introduced into that branch of the electrical business. Its many new electrical and mechanical features commend it to cautious purchasers.

ADVERTISERS' HINTS

THE ELECTRICAL MANUFACTURING COMPANY, 329 Fourth avenue, New York, are carrying a full line of electrical novelties and miniature incandescent lamps.

T. J. COPE, 3244 North Fifteenth street, Philadelphia, advertises a device for threading conduits, which he claims to be the only machine of the kind manufactured. It has a record of many million feet of conduit.

THE KOKOMO TELEPHONE AND ELECTRIC MANUFACTURING COMPANY, Kokomo, Ind., advertise the new "Kokomo" transmitter designed for exchange and long distance service.

THE DELAWARE HARD FIBRE COMPANY, Union and Tenth streets, Wilmington, Del., advertise fibre for insulation, and will send their catalogue and samples on request.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, Cincinnati, Ohio, advertise mast arms with automatic cut-outs for wooden or iron poles.

THE VULCANIZED FIBRE COMPANY, Wilmington, Del., supply "vulcanized fibre" in sheets, tubes, rods and special shapes for insulating and mechanical purposes.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., illustrate their patent tubular arm switch. Their descriptive catalogue of switches, switchboards, panel boards and electrical specialties may be obtained.

I. P. FRINK, 551 Pearl street, New York, submits a list of architects for whom he has installed important work.

G. M. ANGIER & COMPANY, 64 Federal street, Boston, Mass., set forth the merits of the "Paragon" series enclosed arc lamp.

CHAS. E. GREGORY COMPANY, South Clinton street, Chicago, Ill., publish an up-to-date list of bargains in dynamos, motors, arc lamps and transformers, which they have in stock ready for shipment.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., call attention to one of their many styles of switches whose various points of excellence have made them so popular.

WEST POINT, MISS.—The plans and specifications for the city electric light plant are now in the hands of the printer. The contract will be let March 8, 1898. Parties wishing for copies of the documents should address the mayor. The city has on file also plans and specifications for a reservoir to be added to their water work plant.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

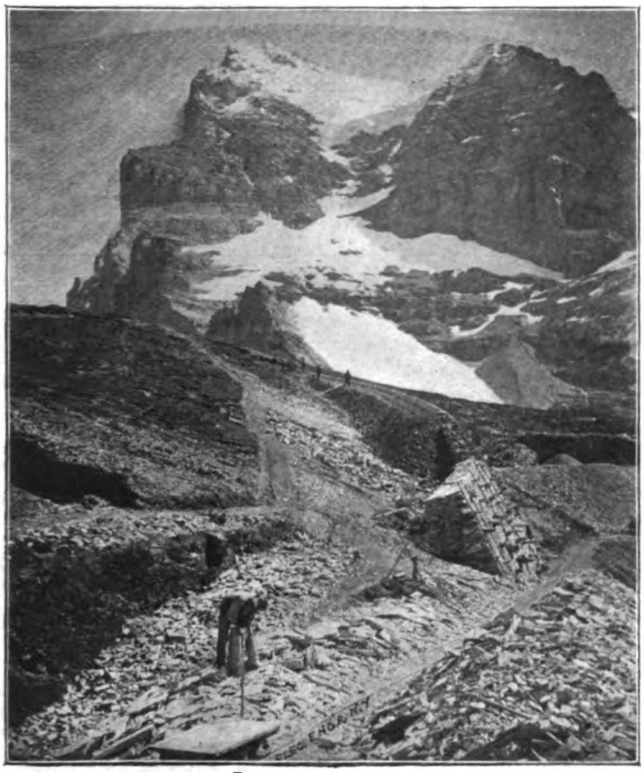
Vol. XXV. FEBRUARY 24, 1898. No. 512.

ELECTRIC TRANSPORTATION

"The Trolley to Heaven"—The Jungfrau Railway.

BY L. BAYLY, E. E.

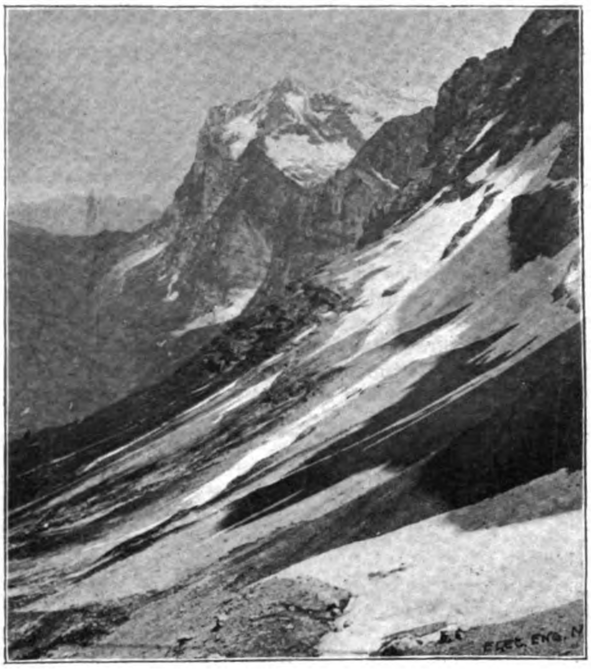
MOST people are aware of the enormous popularity of the recently-introduced cogwheel railways in Switzerland. To a host of its minor conquests Herr Guyer-Zeller's undertaking comes as a worthy and closing triumph to this great century of engineering. For the benefit of those who are not familiar with the main facts about the route adopted, I will condense geographical information as much as possible.[1] After leaving the station at the Little Scheidegg the line winds along at a gentle slope up the Eiger glacier, then, pausing for a moment at the edge of a 6,000-foot precipice—Grindelwald-blick—disappears bodily under the ice, and reappears, after passing beneath the glacier, 3,000 feet higher up, at Mönch. Hence a new tunnel takes us to within a hundred feet of the Jungfrau's summit, where an electrically-worked lift completes our journey.



JUNGFRAU ROAD, FIRST STATION—"EIGERGLETSCHER."

As might be supposed, the gradients on this line vary considerably. The maximum incline between the stations Eigergletscher and Kallifirn—is about 25 per cent., or one mile in every four. The other sections average from 12½ per cent. to 23 per cent. In the construction of the line, horizontal stretches have been avoided as much as possible, a regular strain being deemed more healthy for the machinery than an intermittent one.

The disposition of the rails is the same as on the other Swiss railways. A series of cogwheels, set in movement by electric motors, gear into a cogged rail of peculiar construction. It is of rolled steel, and capable of supporting the weight of the train (about 35,000 kilos) on a gradient of 30 per cent. It comes from the shops of the Bochumer Verein, Zurich. According to geological researches, nearly three-quarters of the rock through which Herr Guyer-Zeller's railway will have to pass on its way to the summit of the Jungfrau—13,000 feet above the sea-level—consists of a brittle, half-crystalline jurassic formation (malm), as remarkable for its resisting powers to weather as for the ease with which it can be loosened by explosives. The remainder of the route will necessitate tunnelling through gneiss. The unvarying temperature of the tunnels—always below zero—renders accidents from a sudden thawing of the ice extremely improbable, and interior brickwork can be dispensed with throughout the greater part of the line.



SECOND STATION—"GRINDELWALDBLICK."

Here there steps in an interesting question concerning the possibility of the geological strata shifting with regard to each other, and thus altering the level of the line in places. To obviate this, the tunnels are to be lined with masonry wherever the strata changes, Portland cement, capable of being applied at a temperature of ten degrees below zero, being used throughout.

UNDER THE EIGER PRECIPICE.

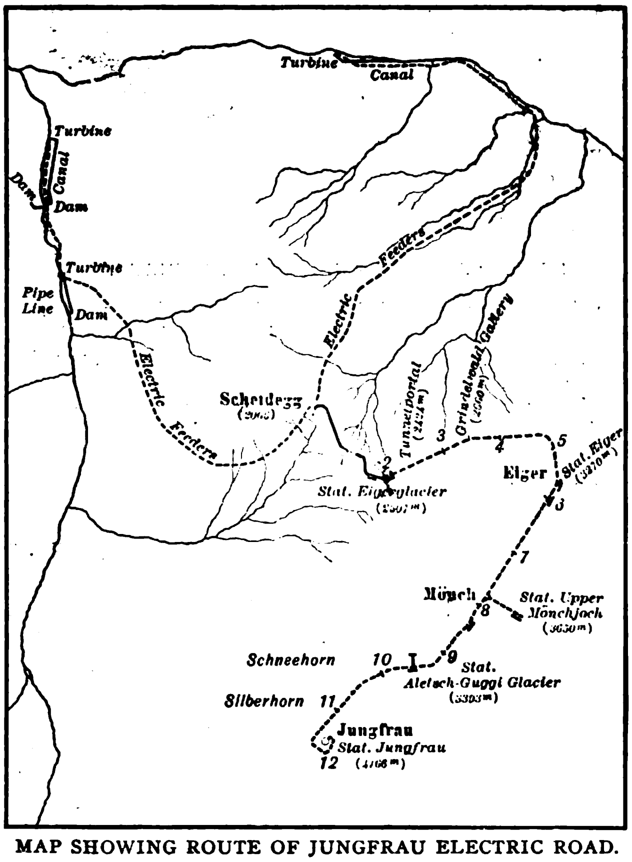
The total cost of masonry is estimated at 250 francs per metre.

[1]Preliminary illustrated articles on this road have appeared in The Electrical Engineer, Vol. XXII., No. 446, Nov. 18, 1896, and Vol. XXIV., No. 490, Sept. 23, 1897.

PERSPECTIVE VIEW, ROUTE OF JUNGFRAU ELECTRIC ROAD.

As already 750,000 francs have been voted for this feature alone. 3,000 metres of the tunnel will be encased, for safety's sake, in masonry.

At first it was feared that difficulties from water might prove perplexing. Starting from the Little Scheidegg, the line climbs gently up the grassy slope of the Eiger and enters boldly under the body of the glacier, not to emerge until it reaches the Jungfrau-Joch, 4,000 feet higher up, from whence it again dives into the snow to complete its journey. Thus it will be seen that the line is practically covered with ice the whole way, and to judge from the boiling torrents that rush from the hearts of these icy giants, it would at first seem very probable that the trip to the Jungfrau summit would be a damp one at best.



MAP SHOWING ROUTE OF JUNGFRAU ELECTRIC ROAD.

Here, however, comes energetic consolation. The temperature throughout the whole length of the tunnels is below zero, and water, save in the form of ice, cannot exist—unless, as Herr Guyer-Zeller ironically remarks, they should happen to strike a boiling spring, in which case pipes will be laid to conduct the water to the nearest station, where it would certainly prove useful.

The tunnels themselves, with a maximum diameter of 14 feet, will be helped along by electric drills, actuated by motive power from the Lauterbrunnen Valley. Experimental tests in stone torn from the precipices of the Eiger and Jungfrau, have already taken place, and have proved entirely satisfactory. The electric drill is as yet in its youth, but Herr Guyer-Zeller's railway seems likely to give it a chance of coming forward.

The attacks on the Eiger slope, commenced a month ago, have served to bring the new explosive, "lithotrit," into growing reputation. It is a compound invented by Herr Alfred Demeuse, of Zurich, and contrasted with the more venerable dynamite, it possesses manifest advantages in price, in the fact that neither heat or cold can touch it, in that neither hammering nor igniting can cause it to explode, and last, but not least, in the fact that its working generates no noxious gases—an important consideration for men who have to tunnel beneath five miles of glacier.

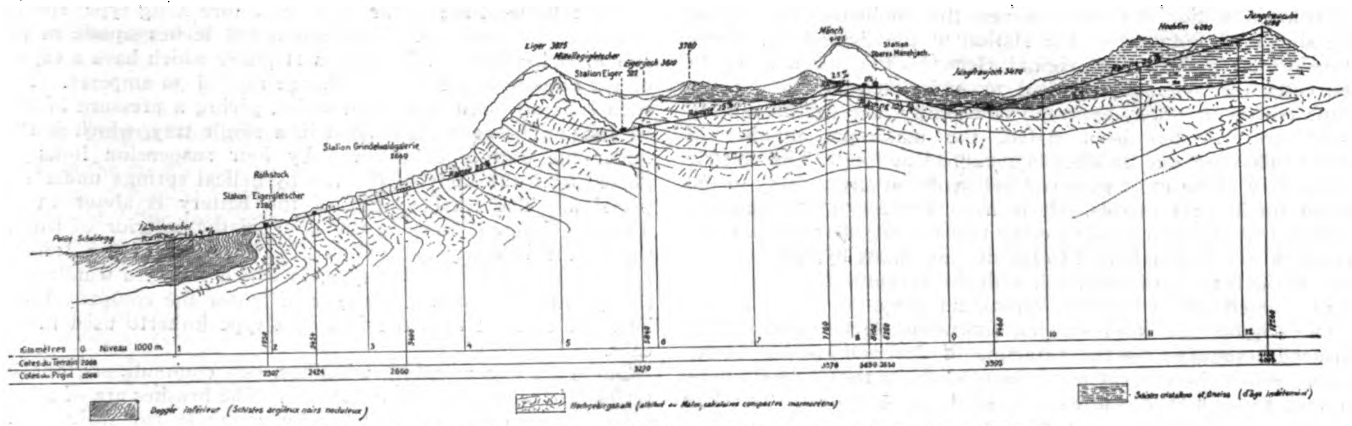
Another curious fact about this new explosive is that it

VIEW LOOKING BACKWARD FROM FIRST STATION.
(The slope of the Jungfrau is on the left.)

possesses the power of burning brilliantly under water. In a seance held by Herr Demeuse, at his workshops previous to the signing of the contract with the Jungfrau Railway authorities, the writer was a witness to this curious fact. The use of lithotrit is also far less dangerous than dynamite, as the nature of the explosion, though sufficient to shatter the resisting structure of rock, does not give rise to that intolerable rain of debris that forms one of the leading dangers attendant on the use of the older explosives.

As mentioned before, the low temperature prevailing in the tunnels renders it necessary to bring all the water used for washing the drills up on trucks in the form of ice, to be thawed by fire or electricity. Instead of being allowed to flow away, thus congealing on the walls or floors of the tunnel, it is freed from its impurities by a system of siphons and used over and over again.

About 350 francs per metre is estimated as the cost of the tunnels, the first five miles being undertaken by a firm of Rhenish engineers, who guarantee an advance of at least four metres a day. It is perhaps generally known that the Peruvian Central Railway reaches in places a height of 4,470 metres



PROFILE AND GEOLOGICAL SECTION, JUNGFRAU ELECTRIC RAILWAY.

above the sea level, without being protected by tunnels. The Jungfrau line, at its highest point, only attains 4,166 metres.

The question of weight in the trains that run to the summit has been settled as follows: One carriage, with seats for 30 people, 15,000 kilos; one baggage wagon, 5,400 kilos; 80 passengers, 5,600 kilos, or a total of 26,000 kilos.

This renders a delivery of

$$26\,(250 + 10)\,8.5 = 212 \text{ HP}$$

necessary at the crank-shaft, or in the case of electricity, at the motor axle.

Each locomotive contains two motors of 125 h. p. apiece, working directly into the cogwheel gearing. The rails are of cast steel, and a brake of peculiar construction, actuated from the interior of the carriage, grips the central cograil and slows the descent when necessary. The usual brake applied to the rim of the cogwheel itself has here been discarded as expensive and unsatisfactory. The ordinary side-rails are by Herr Stumm, of Neunkirche, the cograils coming from the factory of L. von Roll.

The power destined to propel the rolling stock is more interesting from an electrical than from a hydraulic standpoint. Curiously enough, in Swiss rivers, the flow of water may be said to vary happily in proportion to the number of visitors to Switzerland. In other words, it is during the hottest months of the year, when summer drives all good people away to the mountains, that the melting snows of the Bernese Oberland contribute most generously to the Lauterbrunnen torrent.

The mechanical requirements for the railway are fixed at 500 h. p., amply sufficient to pull a train of 80 passengers up a 25 per cent. gradient at a speed of 8.5 kilometres an hour. The losses in power along the line, that is, between dynamo and motor, are estimated as follows:

Motor, total efficiency.................. 90 per cent.
Transformers, total efficiency .... 84 "
Conductors, total efficiency.............. 92 "
Dynamo, total efficiency................ 93 "

Making altogether a total loss of about 50 per cent. This brings the 212 h. p. originally required up to 424—which is exactly the work to be done at the shaft of the turbine.

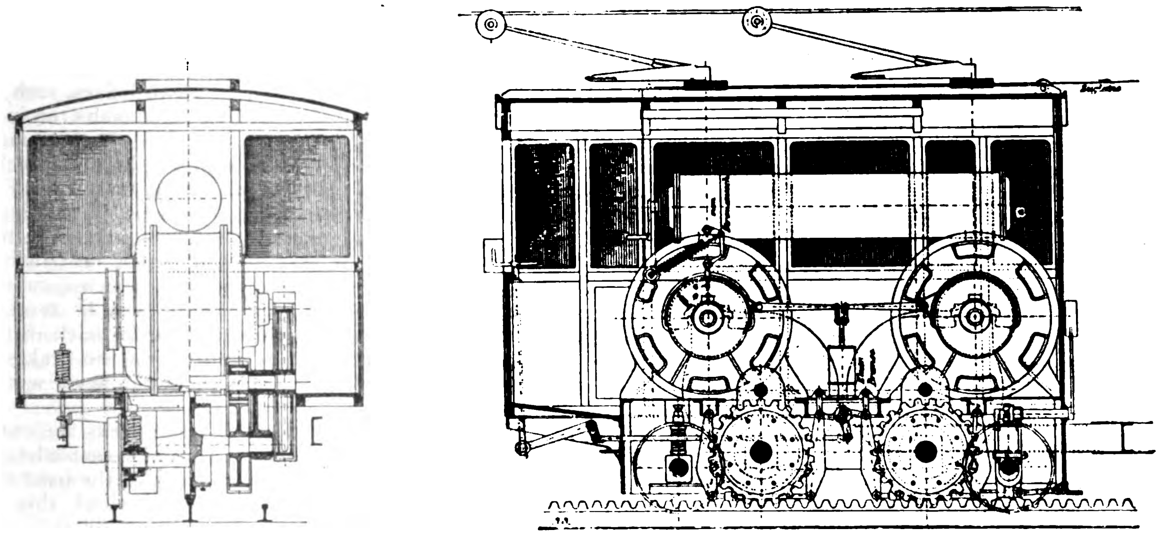
For the lighting of the tunnels separate wires are to be run, and to guard against irregularities, a set of accumulators are to be established at every station. It seems likely that many people, not caring to make the entire ascent, will patronize the railway only as far as the first and second stations, between which, as a result, the train-traffic will have to be increased. An allowance of power for four trains ascending simultaneously has therefore been made. This brings the total of h. p. required up to 2,130.

An aqueduct of 1,315 metres length conducts the water to the turbines. These are four in number, two of 500 h. p. each, and two smaller ones of 25 h. p. each; these serve to work the exciters for the dynamos.

The following are some technical data concerning the installation: Effective fall of water, 35.0 metres; volume per second, 1,430 litres. The cost is reckoned as follows:

	Francs.
Groundwork, foundations, etc.	19,000
Aqueducts, Section 1	147,500
Aqueducts, Section 2	107,300
Turbines and dynamos	230,000
Sundries	55,000
Total	558,000

Electricians have, almost without exception, recommended alternating currents as working most economically for long distances. Two alternative current dynamos are coupled direct to the shafts of the two larger turbines, of 7,000 volts E.M.F. each. The two smaller turbines work the continuous-current exciters, which, as I already mentioned, are of 25 h. p. each.



RACK RAIL ELECTRIC LOCOMOTIVE, JUNGFRAU ROAD.

From the station at Lauterbrunnen, the conductors lead across the slopes of Wengen to the station at the Scheidegg, where transformers reduce the original electromotive force down to 500 volts, the originally-planned 700 volt lines not having, for some reason or other, appeared sufficiently safe to the railway committee. As has been stated, the maximum number of trains following one another is reckoned at four. The electric locomotive is the most powerful yet made on any railway in the world for light railroads. It is from the Swiss Locomotive-Fabrik, and is constructed to carry two motors of 150 h. p. each, whose power is transmitted to the driving-shafts by cog-gearing. The whole is made of cast steel, with the exception of the motor-shafts, which are of a bronze-aluminum alloy.

The engines are fitted with an automatic electric brake, constructed somewhat on the principle of the well-known safety-plug. When the current becomes too strong the "brake" steps in and reduces it down to reasonable proportions. The hydraulic and electrical works have been partially undertaken by Reiter & Co., also by Escher & Wyss, the Oerlikon factory has supplied the dynamos, the Berne iron foundry the trucks and carriage frames.

Brooklyn Bridge Trolley Register.

The electrical device for counting the number of trolley cars that cross the Brooklyn Bridge in connection with the through transit scheme, has been completed by Electrical Engineer C. B. Martin. Under the terms of the contract made by the old board of bridge trustees, a toll of five cents is to be paid for every trolley car that makes the round trip on the bridge, and 12 cents for every elevated car.

The electrical device adopted for counting the trolley cars is the invention of Engineer C. B. Martin, who is in charge of the electrical department of the bridge. The device is one that cannot possibly be beaten by the trolleys, and Mr. Martin is confident that every car crossing the bridge will be recorded. Two of these instruments will be used, one on each roadway, in front of the toll collector. While it is expected that the instrument will record correctly, a three months' trial will be made before it is adopted, and during this period each instrument will be a check on the other, and, in addition, a count will be made by men stationed on the bridge for this purpose. According to the present programme the trolley roads expect to operate cars to the number of 3,000 to 5,000 trips per day. This will give the bridge a revenue of between $150 and $250 per day. The elevated cars, when they finally succeed in completing preparations, are expected to run over the bridge daily to the extent of 2,000 single car trips, or a daily bridge revenue, at 12 cents per car, of $240. The yearly revenue of the bridge from all tolls from cars, it is estimated, will be in the neighborhood of $150,000.

The electrical counting device for trolley cars is primarily based on the use of a series magnet introduced in a special feed wire to an insulated section of the regular trolley wire.

This insulated section is 60 feet long and is supplied from the main feeder by a wire which is coiled into a solenoid. This solenoid operates the arm of the counter every time current is taken by a car passing this 60 foot section. The counter consists of a series of cogwheels which move forward one inch, and this shows that one car has passed over the bridge and one five cent toll is due from the railroads. By a connection with the first counter, the cogwheels in the second counter situated in the main office are set in motion at the same time, and in this way two records are kept by each instrument of every car that passes this point. One counter of each instrument will be placed on the roadway, and probably in the toll collector's box, where he can instantly see that it registers every car that passes him.

An English Post-Office Electric Mail Wagon.

THE London Electrical Cab Company, under contract with the Post Office have been running a mail wagon between the General Post Office and Paddington since the month of January. Between these terminal points two calls have to be made, one at the West Central Office, and the other at the Western District Office. Six journeys per day are made, representing a total distance of 35 miles. The total weight of mails carried is, of course, very variable, but it frequently exceeds a ton. "The Electrician," London, gives the following description of the wagon and its equipment, as illustrated:

The cells used are of the E. P. S. Faure-King type, specially made for this purpose. Each cell is 6¼ inches square in plan, and 10 inches high, and contains 11 plates which have a capacity of 172 ampere hours at a discharge rate of 30 amperes. Forty such cells are used, always in series, giving a pressure of about 80 volts. The cells are carried in a single tray, which is slung under the bottom of the van by four suspension links supported from the body of the van by helical springs under compression. The total weight of the battery is about 13 cwt. Through hinged doors in the floor of the interior of the van the motor is easily accessible. The latter is of the Johnson-Lundell two-pole ironclad type, in which the field winding surrounds the armature. This type of motor the company find to be more efficient than the four-pole type hitherto used in their cabs.

There are two armature windings, two commutators, and two series field windings on each motor. The brushes are of carbon, fed end-on to the commutator by a simple flat spring. The capacity of the motor is about 3½ h. p., and the mean working current about 30 amperes. On the armature spindle is a rawhide pinion having 20 teeth, which gears into the central wheel of the differential gear, this wheel being provided with 62 teeth.

LONDON ELECTRIC POST OFFICE VAN.

To provide for the different speeds of the driving wheels in negotiating curves, the countershaft is in two halves, each half being driven by a differential gear. These countershafts run in self-aligning bearings, and each carries a sprocket-wheel having 18 teeth. Sprocket-chains connect these with the larger sprocket-wheels fixed to the driving wheels, and bearing 120 teeth. Finally, the diameter of these rear or driving wheels is 3 feet 6 inches. The many difficulties encountered in the tires have been met by the use of solid round rubber tires of small cross-section. The controller admits of five combinations, which secures different speeds and tractive force. The motor may be reversed at the slow speed by placing the regulator handle back of the neutral or top notch. The action of putting on the brakes also puts the motor out of circuit, so that the latter never works against the brake.

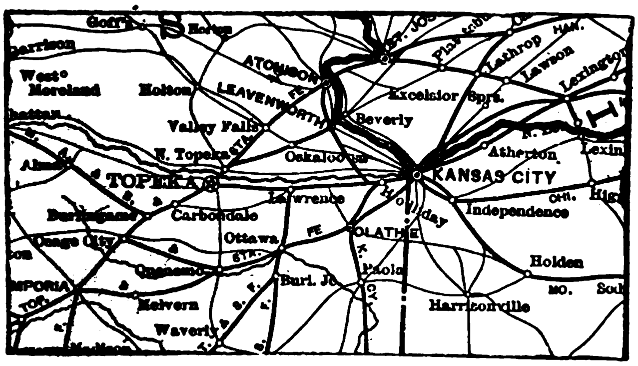
A key is provided by which alone the cells are connected to the regulator, and by which the driver is enabled to leave the van "out of gear." The turntable, to which the front two wheels are attached, is provided with a toothed wheel; this gears into a pinion on a vertical spindle, on the upper end of which is fitted a worm-wheel gearing into a worm operated by the driver's steering wheel. It may be added that the laminated type of sprocket-chain hitherto used on the cabs is being replaced by a chain closely resembling the ordinary bicycle sprocket-chain.

The accompanying illustration gives a view of the mail wagon. The daily service of six journeys is performed with one battery charge, and has, so far, been characterized by perfect punc-

tuality—an essential feature in a mail service. The maximum speed of the van is from 10 to 11 miles per hour on the level road.

Two Important Electric Roads For Kansas.

ONE of the most important newer manufacturing centres of the West is Kansas City, Mo., located on the Missouri River, on the border line between the States of Missouri and Kansas. Surrounded as it is by numerous smaller towns with flourishing trades and markets, and located in a great farming district and near the City of Topeka, shown by the accompanying map, it seems but natural that capitalists are realizing the importance of electric roads to connect Kansas City with its surrounding territory. Recently a company has been formed, with Mr. D. A. McKibben, of Leavenworth, a wealthy capitalist, at its head, which contemplates the construction of an electric railroad between Kansas City and the cities of Topeka and Leavenworth. The road between Kansas City and Leavenworth will curve considerably to the west with two objects in view: one to reach a beautiful farming country, the road passing very near the soldiers' home; the other to avoid two or three steam roads on the west side of the Missouri River. The Leavenworth company contemplated placing their power house at the coal mines in Leavenworth, but this may be abandoned and a greater power



MAP SHOWING THE LOCATION OF KANSAS CITY, TOPEKA AND LEAVENWORTH.

house be erected in Kansas City, Kansas, on the north bank of the Kansas River, and the company will then be able to furnish power to the Metropolitan Street Ry. Co., of Kansas City, Mo., as well as to their own line. By making the curve mentioned they will be able to take in en route, Bonner Springs, which is rapidly becoming known as a health resort.

The Kansas City & Topeka Electric Ry. will build on the south side of the Kansas River, a distance of 60 miles, and it will almost parallel the Atchison, Topeka & Santa Fé Ry., between these cities. There is a very large local trade in farm produce, such as garden truck, butter and eggs, as well as milk, along the entire route, and the steam roads cannot supply this community with facilities for reaching the city at the time needed to dispose of their produce. The electric company propose doing this and will enter upon a great traffic as soon as the road is completed. The power house will be located at Lawrence, and the power will be derived from the water of the Kansas River, which is dammed at Lawrence. They will have an abundance of water power at that point, and it is possible that they may use the dam also at Topeka. An endeavor is being made to get this company, which has ample backing, to use the Leffler system, which was used at Lincoln Park, Chicago, and, while it is operated without an overhead trolley and by the alternating current, has proved very successful. The right of way between Kansas City and Lawrence is mostly provided for and building will commence in early spring. We are indebted to Mr. D. A. Williams, of Kansas City, for the above information.

The Trolley On The Brooklyn Bridge.

THE Brooklyn trolley cars are now running across the bridge to the great satisfaction of the residents of that city who do business in New York. On the morning of February 16 five of the principal lines began making trips under short headway and soon the lines from all parts of the city converging at the bridge will include it in their routes. The time taken to run across is about seven minutes. As the cars approach the New York terminal they are met by two guards who prevent egress therefrom until each has stopped and emptied. After this short interval the new passengers are taken aboard and it is at once started on the return trip in much less time than are the cable cars.

Supt. Martin of the bridge is quoted as saying that by this means the car carrying capacity will be increased 17,000 per hour, or nearly doubled. The bridge trains of cable cars are already much less crowded.

The arrangement of the New York terminal loops has been the subject of much sensational opposition by certain of the yellow dailies, and the horrors of "the latest death-trap" have been tragically depicted. The unprejudiced observer must admit, however, that the danger to pedestrians is no greater than that incurred in crossing any crowded thoroughfare, and of which nothing is thought.

The Philadelphia Gas Works.

BY W. E. DODGE.

IN The Electrical Engineer of Nov. 18, 1897, was the statement that "the gas plant of Philadelphia has been operated on a basis of heavy net loss, and for a long time past has been buying gas from private plants to sell again." It is all right for The Engineer to advocate corporate or private ownership as against municipal, but I submit that it should be careful to not misrepresent the facts. According to the official report of the Director of Public Works, the Bureau of Gas in Philadelphia, from 1891 to 1894, inclusive, had a total expenditure of $10,858,910.58, and for extension of the plant and permanent improvements, $1,050,248.81, a total of $11,909,159.39. During the same time, there was turned into the city revenues from the gas, $14,790,404.25, or nearly three millions in excess of the entire expenses, and that, too, notwithstanding that the price of gas was reduced in 1894 to $1, or 33 per cent.

During the same time gas was furnished free for all the municipal buildings and for street lighting, to the amount of $3,299,122, besides. In fact it was more than that, for in this calculation the gas is put at $1 per 1,000, while for three out of the four years it sold for more than that. It will thus be seen that during those four years the profit to the city was $6,180,366.86—an average of $1,545,091.71. per annum.

I have not the figures for 1895, but for 1896 the official report shows that in addition to the erection of new street lamps, and paying for 224,125 feet of additional mains, the gas works paid into the city revenues $352,988.80, besides furnishing for city use, gas to the amount of $674,031.51, or a total of $1,027,020.31. It is fair to presume that for 1895 the profit was as great, if not greater; and if so, then the profit to the city for the past six years has been $8,234,407.48.

It is true that for some eight or nine years past the city has bought gas of a company which built its works under the control of the city engineer, but that was simply because the city gas works could not supply the city and the suburban demands; and the fact that this private company could build its plant and then sell its gas to the city for 37½ cents per 1,000, and make a profit on its investment, shows how very profitable the gas business is.

It is further shown by the efforts of outside parties to buy or otherwise get control of the gas works, some having offered $25,000,000 and others $30,000,000 for them. Why, if not profitable?

An ordinance has been passed by which the gas works are to be leased to a company for thirty years, with the right reserved by the city to terminate the lease in ten years, and by which the company is to furnish gas free for the public buildings and the street lamps, and to the citizens at $1, with the right of the city to reduce the price after 1907 to 90 cents; from January, 1908, to 85 cents; from January, 1913, to 80 cents, and from January, 1918, to 75 cents per 1,000. The gas is to be of not less than 22 candle power.

In addition, the company agrees to invest $5,000,000 in improving and extending the works within three years, and thereafter not less than $10,000,000 more, or $15,000,000 in all, during its lease of 30 years.

The company is to pay to the city on all gas sold prior to 1908, all that it receives over and above 90 cents per 1,000; on all it sells from December, 1907, to January, 1913; all it receives over 85 cents to 1918; all over 80 cents to 1928; all it receives over 75 cents per 1,000, the city reserving the right to change the price of gas at its pleasure. The company is also to put in service pipes and gas meters for private consumers at its own expense.

Whether the city will make more profit by this arrangement remains to be seen, but there can be no question that the ownership of the gas works has proven profitable, notwithstanding the alleged reckless and extravagant mismanagement under city control. If profitable under such control, how much more so might they have been under proper control.

I am aware that the whole contention in favor of private, as against municipal control, is that under municipal control they cannot, or will not, be honestly and economically managed. Such an argument is not creditable to us as a people, and I admit that where municipal works are run by politicians, or in the interest of political parties, there will be extravagance, if not corruption and waste. But why need they be so run? The remedy for that lies in having them run by a non-political commission or board, which shall be permanent, and be retained during good behavior.

We are far behind European cities in our management of municipal affairs, but there is an awakening of the public all over the country on this subject, that sooner or later will put us on a par with them, in that respect.

Mismanagement of Philadelphia's Water Supply.

A severe arraignment of the mismanagement and neglect in Philadelphia in the matter of water supply was presented at a recent hearing before a committee of the Council. The occasion for the hearing was the public demand that something be done to remedy the conditions because of which the city is disgraced by an epidemic of typhoid fever. It was shown that the prevalence of fever in the city is far in excess of any other city of like rank in the world, and that the cause is the contamination of the streams from which the city draws its water supply; and it was pointed out that, basing an estimate upon the statistics of the Board of Health for the ten years ending December 31, 1897, which show the total mortality from typhoid fever in Philadelphia during that time to have been somewhat over 5,000 deaths, representing about 50,000 cases of sickness, and estimating the pecuniary loss from each death to have been $1,000, and from each case of sickness to have been $100, the citizens of Philadelphia have in that time suffered a money loss of some $10,000,000, which could have been absolutely prevented by filtration of the water. This would not only have paid for filtering the water supply, but would also have prevented all this disease and death. An irreverent Philadelphian asked once to describe the drinking water furnished by the city, said it was the kind Christ walked upon.

Municipal Electric Lighting.[1]—I.

BY PROF. JOHN R. COMMONS.

IN advocating municipal electric lighting I accept the burden of proof. I agree that government, whether national or local, cannot safely undertake experiments on a large scale. The assumption of new functions must be shown to be not merely desirable in the interests of a few, or adapted to the doctrinaire ideal of a well-rounded form of government, but it must be shown to be necessary and essential for the preservation of important interests affecting the welfare of the entire body of the people. Governments do indeed enter upon experiments, and the assumption of a well-established industry may itself be called an experiment. But in the sense in which I use the word, the introduction of new modes of manufacture or service and the creation of new wants among the people are matters involving risks of an incalculable and speculative kind, and this is not the business of government. Private parties should be encouraged to push forward in all the untried fields. If their ventures are unsuccessful, if they are ahead of their times, failure and bankruptcy will affect only them and their immediate dependents. Successors will come in, and if the service in question meets a truly growing need of the people, success and fortune will follow. But if government ventures upon the sea of uncertainty, bankruptcy means the beginning of anarchy. Government does not perish like the individual or the corporation, and failure on a large scale, if it involves repudiation or oppressive taxation for years to come, produces a popular revulsion and deep-seated distrust of government itself in all its departments.

A criticism should be made upon those cities which entered upon municipal electric lighting eight or ten years ago. Here was a new agency utterly unknown as a commercial quantity; new machinery of all degrees of imperfection and uncertainty; cost of operation, depreciation, risks, unsettled; engineering and mechanical requisites on the part of employés quite indefinite; public opinion not yet crystallized through adequate discussion and experience. In face of all these uncertainties, it would not be strange if many cities have incurred debts for fabulously priced machinery which a few years of experience have since discarded, and if the reaction has driven the citizens to the best kind of a bargain they could make with private companies. It is reported that eight or ten towns and cities which had installed municipal plants have abandoned their undertakings and sold out to private companies at a serious loss. That the number is so small, considering that nearly three hundred cities and villages have adopted municipal ownership, certainly speaks well for the industrial ability of our small cities. On the other hand, the fact that these failures have not prevented an astonishing increase in the number of municipal plants indicates some deep-seated causes which are worthy of our attention. In the State of New York alone, the six municipal plants of two years ago are now increased to twelve and possibly more.

MUNICIPAL FUNCTIONS INCREASING.

Municipal functions have increased very slowly. Cities have accepted the principle, just as every advocate must also do, that the burden of proof is against the assumption of new functions. Natural lethargy and difficulties in the way of co-operative action have been important checks, but equally or more important has been that wise Anglo-Saxon conservatism which makes sure and impregnable every acquisition in civilization before advancing to new fields. In the matter of electric lighting only weighty and even vital considerations can push forward the movement for municipal ownership over any extensive range of cities. As far, however, as the experimental character of the industry is concerned, fifteen years of experience and marvelous inventive progress have reduced electric lighting to a system and made all its parts and details as readily calculable as any of the functions in which cities are now engaged. The rapid growth of cities themselves with an assured increase of demand for light and power, combined with the perfection of the mechanical equipment, and the fairly reasonable competition between producers of the same, have removed for the present the weight of any criticism similar to that which might attach to those cities which ventured upon this field in the early days of the industry. The questions which now present themselves to cities considering the proposed operation of municipal plants are, therefore, greatly simplified by the elimination of these strictly mechanical questions. The new problems are of a quite different character. They may be briefly summarized under the headings—improved service, diffusion of use, stimulation of industry and purification of politics. These apply to all industries requiring a municipal franchise, and with the growth of a city, anyone or all of them may gather such increasing weight that the city is compelled to assume the operation of the industry in question. Streets and alleys have, of course, long since been municipalized, and it would be utterly intolerable even in small villages if vehicles and horses were subjected to tolls at various street intersections. The sewerage system comes next in urgency. Only three cities in the United States have private-owned systems of sewers. This service must be made universal and must be of the highest quality for both poor and rich sections. It, therefore, like the streets, has been municipalized and made entirely free of tolls. New Orleans with its private sewers is suffering not only from inadequate sewer service, but from corrupt politics growing out of such service. Water-works follow sewers in the extent of municipalization.

[1] Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec. Engr.

MUNICIPAL LIGHTING SUCCESSFUL IN SMALL CITIES.

In electric lighting the process of municipalization is as yet mainly in the small places. While but three cities over 100,000, according to the census of 1890, have municipal electric plants, it appears from the list of sixty-four cities with municipal plants, as given by Mr. Francisco,[1] that twenty-nine have less than 5,000 population, nineteen from 5,000 to 10,000, making a total of forty-eight, or three-fourths, under 10,000, and fourteen range from 10,000 to 50,000. The fact that the preponderance lies so largely on the side of the small cities and villages is sometimes advanced as showing that large cities are not competent to undertake this function. While such a conclusion is, of course, not logically warranted, there are patent reasons why municipal ownership should achieve its first success in the smaller municipalities. Here, as I have already said, government lies close to the people. The officials are known to every one. They cannot retire under the shield of their friends and party councillors. They are accessible to the personal complaints of every one. In large cities newspapers do the complaining, and everybody discounts these as the organs of partisanship or corporate jobbery. The people do not come in contact with their officials. But it is otherwise in the small cities, and the result is a constant effort on the part of officials to meet the demand for efficiency and economy.

The voting constituency, too, has a preponderance of small property owners, the thrifty and independent middle class, who have always been the bulwark of popular government. There are no multi-millionaires on the one hand and no overwhelming array of wage-workers dependent upon them upon the other. This relieves the community both from the machinations of a few rich men who in every city use their power to exploit their neighbors, and whose interests are, therefore, against honest government; and also from the blind struggles of the working classes to secure through politics those advantages and liberties which they are unable to obtain in industry. This makes both the administration of the civil service a simple matter, and the hours and wages of labor in public employment conform to the most exacting conditions that obtain in private industry.

Below is a table showing for street plants in large and small cities, the varying costs of labor per arc light for public and private plants.

TABLE I.

Cost of Labor per Arc Light.

1. Labor Employed, 72—84 Hours per Week with Water Works Plant.

	Arcs.	Per year.	Per lamp hour.	Authorities.
Dunkirk, N. Y......	75-2000	$a12.18 b12.95	$a.0039 b.0044	a Computed, '97, b Foster.
Batavia, N. Y......	103-2000	19.21	.0056	Computed 1897.
Herkimer, N. Y....	55-2000	28.58	.0097	Computed 1896.
Marshalltown, Ia...	64-2000	9.19	....	Computed from Mayor's figures.
Lewiston, Me......	100-2000	22.00	.0079	Foster.
Bangor, Me........	150-2000	24.00	....	Parsons.
Goshen, Ind	40-2000	31.00	....	Parsons.
Wheeling, W. Va. (with gas)........	....	37.	....	Parsons.

2. Labor Employed, 60—84 Hours per Week—Street Plants Alone.

	Arcs.	Per year.	Per lamp hour.	Authorities.
Watervliet, N. Y.	103-2000	$a25.00 b24.44 c26 61	$ 0062	aParsons. bFoster c Computed '97.
Easton, Pa......	108 2000	a22.76 b28.00	.0075	aFoster. bParsons.
Elgin, Ill........	98-2000	32.50	....	Foster.
Bay City, Mich...	103-2000	a17.16 b24.00	.0071	aFoster. bParsons.
Aurora, Ill.......	179-2000	28.50	....	Parsons.
St. Joseph, Mo...	153-2000	27.50	....	Parsons.
Fairfield, Ia.....	14-2000	a26.00 b12.08	.0178	aParsons. bFoster.
Painesville, O...	70-2000	20.00	....	Parsons.
Little Rock, Ark.	a132-2000 b210-2000	a35.12 b21.00	.0162	aFoster. bParsons.
Topeka, Kan....	181-2000	34.00	....	Parsons.

A Toronto Report Adverse To Munucipal Ownership.

At a meeting of the City Council's special committee on electric lighting, Engineer Rust was summoned to give the probable cost of installing a civic plant, and said it would reach for all the municipal lighting perhaps $400,000. They would need 2,000 h. p. There are at least 1,100 street lights of one horse-power each, and the new municipal buildings will take 4,000 incandescent lights. The plant for commercial purposes would cost $103,000, and it is not likely that the city would be able to reduce the rates now current. He estimated the cost per street light as only 5 cents less than the Toronto Electric Light Company is now charging.

The mayor thought that it was beyond the city to put up buildings and go into the supply of electrical energy. There was a vast storehouse of energy not far away at Niagara. Surely the company there would be able to supply Toronto with energy more cheaply than the city could manufacture it from coal. He expected to have reliable information from that company himself. No action was taken.

[1] "Municipal Ownership; Its Fallacy," p. 39.

The Municipal Plant at Emporia, Kan.

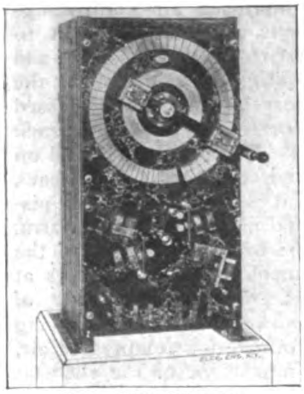
A reader at Reading, Kan., sends us the accompanying newspaper item as to the municipal plant at Emporia, Kan.:

"Councilman Weyler said some time ago that he thought the city would save about $1,800 in six months by owning the electric light plant. According to the figures in the city clerk's books, the expense account for the five months, during which the city has owned the electric light system is as follows: 'September, $537.94; October, $407.98; November, $572.49; December, $561.77; January, $797.43; total, $2,877.61, or an average for each month of $575.52. The city has received during this time $335 for lights. When the city rented the fifty-six and fifty-seven lights it paid from $504 to $513 a month for them. The $1,800 that it was thought the city had saved does not appear on the books."

Our correspondent adds that he understands, in addition, that the city of Emporia has a debt of $17,000 on a second hand plant.

OSAGE CITY, KANS., is to vote on the purchase of the private plant there, and the municipal running of same. The city is to pay $2,500 a year for three years, and then own the plant outright.

Electrical Control and Operation of Newspaper Presses in the News and Record Office, Chicago.



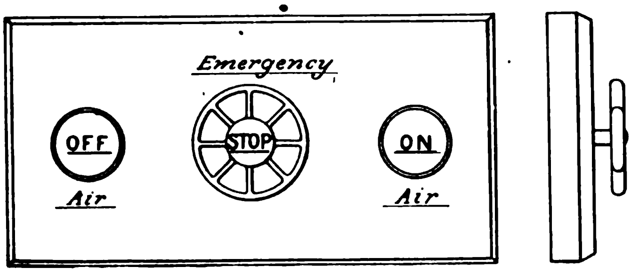
Controlling Rheostat.

THE publishers of the two great Chicago dailies, the Chicago "Record" (morning), and the Chicago "Daily News" (evening), will, on February 23—just before this article appears—dedicate a new press room. As a matter of course electricity plays the important part of furnishing motive power for the two presses in this room, as electric motor drive is indispensable to a strictly up-to-date press room, and in fact its use for this purpose has almost ceased to be a novelty.

The principal interesting feature of the "Daily News" plant, to the electrical engineer, is the method of control, which differs from anything previously employed in several respects, and presents several refinements not heretofore used. The credit for the perfection of the plant is due to Irving Stone, mechanical engineer of the "News" and "Record" properties, and one of the leading specialists in daily newspaper engineering in the country. He had also, at the time the plant was installed, the active co-operation of the Gibbs Motor Company, of which Kohler Brothers were the Chicago agents, and the Cutler-Hammer Manufacturing Co., which furnished the electrical controlling apparatus. The Gibbs Company was recently absorbed, we understand, by the Westinghouse Electric Manufacturing Company.

The new press room, although only now formally opened, has been in actual daily service for some time. It contains two large Hoe newspaper presses, each with a capacity of 22,000 per hour. The floor of the press room proper is on a level with the street. Under the presses is a light, roomy basement where the paper reels and electric motors are located. Quick communication between the basement and press floors is afforded by automatic compressed air man elevators for going up, and poles for sliding down. The latter are a familiar sight around fire engine houses. The former are a novelty both in press rooms and elsewhere. An elevator consists of a round plate large enough for one man to stand on, operated by compressed air, acting against a piston from below. When a man steps on one of these plates (which is located in a shaft running up to the next floor), his weight automatically trips an air valve and after a fraction of a second he is shot up to the next floor, where he immediately steps off and the plate slowly returns to the bottom ready for the next comer. A small compressed air plate elevator is also used.

The main motors driving the presses are put on a built-up foundation under each press and are directly geared to the presses. Each press has a 220 volt motor of 40 h. p. furnished by Kohler Bros. Attached to the basement ceiling under each press is also a small shunt-wound motor, for running the press slowly when making ready. This small motor is governed by a rheostat to run from 160 to 210 revolutions per minute, and at the latter speed develops about five h. p. It is worm geared to the driving shaft of the press; whereas the main 40 h. p. motor



FRONT OF JOHNSON MOTOR CONTROLLER.

is conected to the same shaft by spur-gearing. A clutch working on the principle of a ratchet is put between the worm gear and the driving shaft of the press, so that when the large motor is turned on it does not drag the small worm-geared motor along with it, but leaves it free to be shut down whenever the press speed exceeds that of the small motor.

The controlling rheostats of both large and small motors are worked by compressed air, and compressed air controlling-handles are placed at numerous points around each press to afford convenient and instantaneous control both for service and emergency purposes. The accompanying engraving shows the rheostat for one of the 40 h. p. motors before the compressed air appliances were put on. The rheostat is worked by a rack and pinion and air cylinder at the back. The pinion is placed on the shaft of the rheostat which extends out through the back of the case and the rack which turns it is connected to the piston of the compressed air cylinder. To move the rheostat arm, air pressure is let into one end of the cylinder and out of the other. The air is controlled by Johnson motor controllers at numerous places around the presses. The arrangement of pushes on these press controllers is shown in the accompanying sketch. The pushes marked on and off are for compressed air, and when used give a rather slow movement of the rheostat handle. The middle push is an electrical contact for instantaneously stopping the press in emergency cases. This is done as follows: The catch, with a magnetic trip, which is shown at the right hand lower corner of the front of the rheostat, holds the contact lever switch normally at off position, as in the engraving. The trip magnet is worked by a battery circuit and can be operated from any of the controller middle push buttons. Closing the trip magnet circuit makes the catch let go of the circuit breaking contact arm, and it flies into the reverse position from that shown in the engraving, shutting off the connection of the motor with the line and closing its armature circuit through a resistance, so that it acts as a dynamo to make an electric brake. A quick stop is often important with one of these presses, on account of the speed at which they run and the rapidity with which trouble piles up when a sheet breaks or other mishap occurs. As soon as the circuit breaker acts, in addition to opening the circuit and making an electric brake of the motor, it trips an air valve, which causes the rheostat arm to return to "off" position. As soon as the rheostat arm has reached "off" position another air valve is tripped by it which operates a piston which resets the circuit breaker arm, so that the whole apparatus is ready to go ahead again within a few seconds of the time an emergency stop has been made and no attention from the pressmen is needed. No automatic device for opening the circuit when the current supply is shut off accidentally is considered necessary here, because the pressmen are always on the alert to notice any slight slowing down of a press and always shut off power instantly whenever it occurs, so as to prevent any possible accident due to something going wrong with the press. Their watchfulness to protect the press thus serves the double purpose of protecting themselves and the electrical apparatus.

The fields of the 40 h. p. motors are compound wound, and provision is made on the last few segments of the rheostat to short circuit some of the series turns to increase the speed. The controlling rheostats for the two presses are placed upon a high platform in one corner of the press room, and being operated by compressed air and electricity, it is not intended that they shall ever be touched except for cleaning and repairs.

Mr. Stone has provided a very useful little device for automatically stopping a press whenever a sheet breaks or loses its tension, and thus saving costly accidents. One of the rollers around which the paper passes on its rapid journey into the press is held in position by the tension of the paper which passes around it. Should a sheet tear this roller would fall away from its normal position and make an electrical contact which would stop the press without waiting for a pressman to do so. This is done very simply and easily with the method of electrical control employed.

In addition to the rheostats of the type shown in the engraving, there are, of course, double pole switches in the main supply circuits. Current is taken either from the Edison street mains or the "Record's" own plant. It is expected to enlarge this latter and eventually use electric drive throughout.

ELECTRIC LIGHTING

Memorandum on Mr. W. S. Barstow's "Load Factor System of Charging for Electrical Energy."

BY WILLIAM A. MOSSCROP, M. E.

A VERY serious error will be found in the method of apportioning the cost of fixed expenses per kilowatt hour to the different hours of the day as it was described in Mr. Barstow's article, entitled "Load Factor System of Charging for Electrical Energy," printed in The Electrical Eingineer of Jan. 13, 1898.

As an illustration of the effect of the error's correction on the results, it may be pointed out that taking values from Fig. 2 of the article[1], the cost of fixed expenses per kilowatt hour at 8 p. m. will be nearer 7 cents than 20. The minimum rate, however, would not be affected by the correction but would remain as shown in Fig. 2 of the article.

At 8 p. m. the charge proposed to be made against a customer to cover the cost of fixed expenses per kilowatt hour is taken from the dotted line in Fig. 2; it equals 20 cents and it is proposed to make this charge for each and every kilowatt sold at this hour.

Reference to the rules laid down in the article will make it clear that this charge should be made only against the kilowatts found in block J at the top of Fig. 1. And that in block A at the bottom of Fig. 1, the cost of fixed expenses per kilowatt hour at 8 p. m. will be the same as at 7 a. m. From Fig. 2 it will be found to be only about 1.7 cents. Each intermediate block, at this hour, will have its own cost of fixed expenses per kilowatt hour, as determined by the rules laid down in the article.

The generating station would experience some difficulty in

[1]The figures referred to have been reproduced for convenience.

determining who was using current at 8 p. m. in each of the blocks. Therefore, in order to fix a just charge per hour for

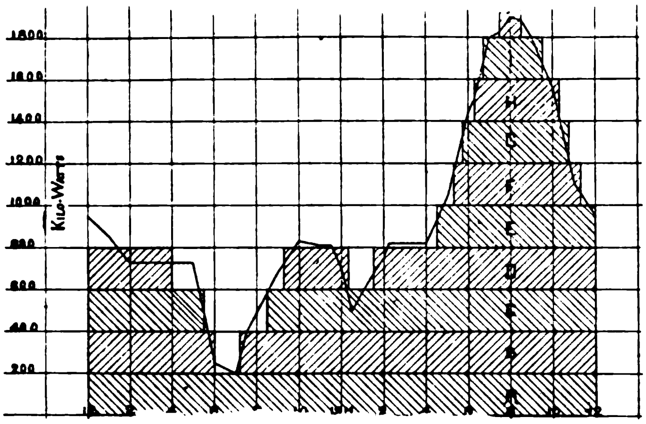


FIG. 1.—AVERAGE LOAD CURVE.

each and every kilowatt sold at 8 p. m., it will be necessary to average the costs in every block at this hour.

To obtain the charge at any other hour, it will be necessary to average the costs in the proper number of blocks as deter-

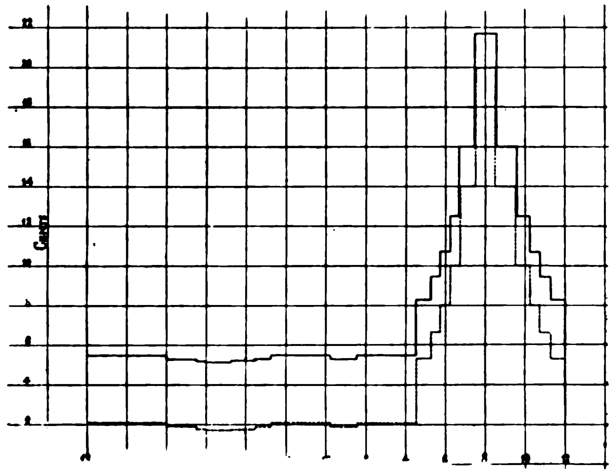


FIG. 2.—AVERAGE EXPENSE CURVE.
Dotted line shows fixed expenses. Solid line shows total expenses.

mined by the load on the station at the hour for which the charge is desired.

Electric Lighting on the Diamond Shoal Light-Ship.

LIGHTSHIP No. 69 has now been anchored on the dangerous Diamond Shoal off Cape Hatteras in 30 fathoms for three months, and having ridden through the gales that prevail off that perilous spot on the Atlantic in entire safety during the roughest weather, has proved to the satisfaction of the Lighthouse Board that a light vessel can safely be maintained there. The captains have now become familiar with the light, and until the ship is replaced by a lighthouse as originally intended, she will be a beacon to be carefully watched for and avoided.

Nos. 68 and 69 are sister steamships built at the yards of the Bath Iron Works, at Bath, Me. No. 68 is the lightship off Fire Island. Both 68 and 69 are unusually powerful composite vessels, 122 ft. 10 in. long over all, 29 ft. 6 in. extreme beam, and 22 ft. moulded depth. They are provided with propelling machinery to enable them to steam to their stations, and, also in case of necessity, to steam away from their dangerous positions. The engines are simple condensing vertical, with a cylinder 20 inches in diameter and 22 inch stroke, developing 350 h. p. at 150 revolutions. Steam is furnished at 100 pounds pressure by a steel Scotch boiler 12 ft. 2 in. in diameter and 11 ft. long. Two vertical donkey boilers furnish steam for the electric lighting plant, windlass, pumps, fog signals and for heating. The vessels are also fitted with steam steering gear, bells, a steam winch and full equipment of anchors and chain cables.

The two masts are of steel; each exclusive of the flag pole 64½ feet high. The electric lights are suspended at the mast heads, and are surrounded by a gallery for day signals.

To avoid chance of breakdown the electric plant on each vessel is in duplicate. Each plant consists of two marine gene-

FIG. 1.—DIAMOND SHOAL LIGHT SHIP.

rating sets with dynamo and engine both built by the General Electric Company of Schenectady, N. Y. The four pole dynamos are 8 kilowatt 650 revolution machines, directly connected to 4½ in. x 4 in. double cylinder engines. The switchboards are of Vermont marble, and the wiring appliances used throughout are of the type approved by the U. S. Naval Board of Inspection. The dynamos furnish 100-volt current to eight 100 candle power lamps, four at each masthead, and forty 16 candle power lamps throughout the vessel. The masthead lights are each enclosed in a lens lantern, three being used and the fourth held in reserve. Connected in circuit to the masthead lights is a device making and breaking the circuit and lighting and extinguishing the lamps at regular intervals. A fixed white light shows for twelve seconds and is followed by an eclipse of three seconds. The focal plane of the lights is 57 feet above

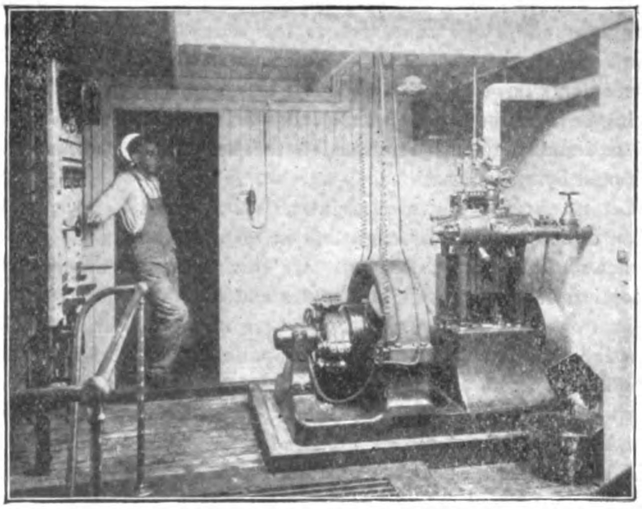


FIG. 2.—DIAMOND SHOAL LIGHT SHIP, DYNAMO ROOM.

the sea, and they will be visible thirteen nautical miles away in clear weather. Great reliance is placed upon the electric plants and in their construction more than ordinary care has been taken. We are indebted to the courtesy of the New York "Tribune" for the photographs from which the illustrations were made.

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Standardizing the Electrical Industry.

ANY industry which has been sufficiently developed to permit of a universal adoption of standards and the compilation of a vocabulary may be said to have reached that stage of perfection which makes possible an international interchange of its products and facilitates their introduction into the workshops and homes of the people. To effect standardization and a harmony of speech and customs among the nations of the earth, as far as differences of climatic conditions, surroundings and government would permit, have been the desires and earnest efforts of humanity from time immemorial. The tower of Babel was never completed because its builders lost their common standards. Since that time every success of human enterprise can be traced to a union of forces, a union of thought and a unanimity of purpose. Again and again fruitless attempts have been made to introduce a universal language, to have the metric system adopted by all civilized nations, to get one value for the pound and the horse-power, and only lately did the international postal congress adopt the same colors for stamps to represent the same values throughout the world. All these international agreements have to pass through a natural course of evolution, being born in the mind of some individual, indorsed by societies of national repute, recommended to the various nations and adopted by an international Congress.

Let us turn to our own electrical sphere, and see what has been done by electrical engineers in bringing about the standardization of their profession. By this we mean the general adoption of units, words, laws, rules and diagrams, and a standardization of machinery. We must here necessarily draw a distinction between international, national and local or municipal standards, and not attempt to effect international agreement of matters which are governed solely by national or municipal conditions. The electrical units, after years of patient labor and the meetings of numerous congresses, have at last received names, values and definitions by international agreement. The laws governing electrical phenomena have been stated in various tongues in as many different ways, but, being subject only to facts and investigation, they are unalterable. The electrical nomenclature must needs be evolved by national custom and agreement, save the names of the units which require international sanction. The rules governing the installation of machinery, wiring, etc., have just been revised by representatives of several national societies and will soon be adopted, we expect, by the entire electrical engineering profession and its kindred interests. The standardization of electrical machinery is now under discussion and we believe will soon be disposed of in a satisfactory manner by the representative electrical body of the United States.

Thus we see that all questions which require united council and action for their final settlement have received their due attention, except the standardization of electrical diagrams. This problem has been attacked by many able men, and only a few years ago we published the splendid chart of electrical diagrams compiled by the champion of electrical standardization, Dr. F. B. Crocker, to whom much credit for much of this good work done by the electrical engineers of America is due. This chart of diagrams of Dr. Crocker has lately served as a basis for the praiseworthy work undertaken by the Chicago Electrical Association, the result of which is a complete set of standard electrical diagrams, which we publish as a supplement to this issue. The universal adoption of these simplified diagrams should follow at an early day, as the value of an easily read diagram cannot be overestimated. It educates, saves time and prevents errors, and will assist in the final triumph of electrical standardization.

Municipal Ownership and Niagara Power for Toronto.

FOR some time past the city of Toronto, Canada, has been discussing a municipal electric light plant, but at the latest official meeting on the subject, the mayor made some very sensible and level-headed remarks. An engineer's report had shown how small was the amount the city could expect to save, at the best, but the mayor pointed out that it was very absurd for the city to invest in a large power generating plant just at the moment when Niagara power might be said to be literally knocking at the door. The availability of that power for Toronto cannot be questioned, the distance between Niagara and the city being only some 75 miles. The generation of current on the Canadian shore at the Falls is cheap and easy, and the figures made by some of the leading engineers in this country, based on a potential of not more than 25,000 volts, prove that the matter has entered into "practical politics" for the progressive city on Lake Ontario. Each day, electrical engineers know better how to handle these large currents and high voltages, and Toronto can well afford to await the lapse of the few years now standing between her and Niagara power.

It will be noted that the mayor of Toronto puts the matter of a municipal plant on a commercial basis. So did Mayor Wurster, of Brooklyn, the question of city water works:

"The mayor was then asked if he believed it would be more advisable to buy the water supply for the city outright than to secure it by leasing of water privileges. In reply he said: 'It is purely a matter of business. If it can be shown that the city can buy water cheaper than the cost of pumping it then it would be profitable to buy it, for under such agreement the seller would have to deliver the water to the city. It is a purely business matter, the same as if a man in one line of business requires certain material in conducting that business. If he could buy it from a man who has a plant for manufacturing it, at a less cost than it would be for him to manufacture it himself, he would not be much of a business man if he did not avail himself of the opportunity to buy the material.'"

The commercial test is certainly as good as could be applied. There are others, but such plants must be judged by their fruits, and we must confess our inability to find other fruit, as a gen-

eral thing, than deficit, or failure, or inefficiency or obsolete apparatus, or all shortcomings mixed up together. Mr. Dodge, in our current issue, makes out a case for the Philadelphia gas works. All we will say, in comment, is that alarming figures were presented to the public before the lease of the works was made, and that amongst other items, it was shown that one man in private gas works elsewhere was expected to do comfortably the work done by eight municipal workmen in Philadelphia. In 1883 a committee of the leading citizens presented a memorial to the Pennsylvania Legislature saying: "Philadelphia is now recognized as the worst-paved and worst-cleaned city in the civilized world * * * Inefficiency, waste, badly paved and filthy streets, unwholesome and offensive water, and slovenly and costly management have been the rule for years past throughout the city government." The little statement following Mr. Dodge's article shows that pretty much the same complaint—not by us however—is made to-day. It is the same everywhere, with a steadily downward pressure, no matter how good some administrations and some individual officers may prove. Just lately, the Lighting Commission in a Western city has been standing up bravely against the desire of aldermen for more lights in their respective districts. Does anybody doubt that sooner or later, those lights or others equally needless will be strung up? The opportunity to bribe constituents in this fashion is a great temptation, and helps explain why municipal enterprises are so often costly and disastrous.

Stealing Telephone Service.

THE fine of five shillings ($1.25) may be a small one, but it is enough to mark the fact that stealing telephone service is a crime. This form of misdemeanor has just been classed in England, by the Croydon police magistrate, as petty larceny, and punished in the above manner. A young man who was the culprit used a false key to admit himself to the public telephone booths of the National Telephone Company, which he thus used without payment; and he was caught.

Perhaps if more people could be brought to understand that when they help themselves to free telephone service, they are stealing, there might be a decrease in the dishonest practice; but the trouble is, they do not stop to think about it. In a measure, the subscriber who allows the free use of his instrument is a party to the offense and is helping not only to cheat the telephone company, but to inflict poorer service on his fellow subscribers; but we all find it difficult to be ungracious when a man comes into our offices and begs to be allowed to use our telephone a moment. On the old flat rate basis, it didn't seem to matter much, anyhow, except to the company; but now when the whole telephone service is gravitating to the metred basis, the practice should stop. Indeed it is stopping automatically in offices with telephones installed on the basis of so much money for so many calls. If the subscriber wishes to be gracious he does it at his own expense, to which there is no objection.

Thermostats and the "Maine" Disaster.

FOLLOWING the anxiety and doubt caused throughout the Nation by the destruction of the U. S. battleship "Maine," we are promised a most rigid investigation by the authorities into the cause of the disaster. It is not our purpose to discuss whether the loss of the ship was due to accident or the work of some miscreant, but the accounts thus far published have served to show an apparent omission in the equipment of our war ships which appears to us serious. Granting that the explosion on board the "Maine" was due to the overheating of the magazine, caused by spontaneous combustion of coal in the adjoining coal bunkers, it would seem that precautions were not taken to ascertain the temperature of the magazine and coal bunkers at sufficiently short intervals. According to the newspaper accounts, the temperature of the magazine was taken at stated intervals during the day, but it seems only too obvious that such periodic inspections by a thermometer cannot adequately guard so vital and dangerous a portion of the ship's equipment. The most natural thing to suggest to guard against future accidents of this kind would be the placing of trustworthy thermostats in the coal bunkers and magazine. If it should appear that no device of this kind had been found satisfactory for this purpose, we are certain that very little experimenting would develop one adequate for the purpose. We know of several thermostats, which, with suitable mechanical protection, would answer the purpose perfectly. This, of course, need not stand in the way of protecting the magazine from overheating by cooling machines and similar devices employed in various navies, but a continuously acting thermostat would appear to be a sine qua non. We suggest that our naval authorities give this matter their early consideration, in order to guard against such catastrophes on our present warships. We may add that a number of vessels of our merchant marine are already protected by thermostats, as a safeguard against fire.

Electricity in the Newspaper Office.

THERE is scarcely a meeting of manufacturers or other trade association which does not find it profitable to discuss electricity in some form or another in connection with their business. This was again shown at the recent meeting of the Newspaper Publishers' Association, which met in New York last week. In discussing the mechanical work of the newspaper office the electric motor came up quite prominently, and the question put before the association was as to the most economical electric motor for newspapers, and what saving is effected by direct connection with the press and by use of low speed instead of high speed motors. There can be no question, of course, that the low speed direct connected machine will survive, for reasons which are obvious. The convenience of direct connection as against belting, added to the lower momentum of the direct connected slow speed machine, which allows of a quicker stopping of the press, will probably always decide the question in favor of the latter. We note also that the association discussed the question of employing electricity as a heating agency for the melting pots of the linotype machines in case the supply of gas should give out. We would suggest that even without waiting for the latter eventuality, the substitution of electric heat for heat by gas would be in every way desirable. Any one who has entered a printing office employing linotype machines will be struck, not to say overcome, by the noxious gases and the frightful heat prevalent in such offices. These constitute a constant menace to the health of the machine hands, and cannot fail to reduce their working capacity. We would suggest that manufacturers of electric heating apparatus look into this matter, in order to still further increase the value of the justly celebrated linotype machine.

As another feature of electrical work on newspapers we may refer to the interesting article that apears in our pages this week on the electrical control of newspaper presses. It describes the methods adopted in the "News" and "Record" offices in Chicago, and shows how far a little ingenuity will go to simplify and assist the operations of a busy printing room at the moments of greatest pressure.

MISCELLANEOUS

Conventional Electrical Diagrams.—The Chicago Electrical Association.

WE present in a double Data Sheet supplement with this issue the Conventional Electrical Diagrams embodied in the report of a special committee of the Chicago Electrical Association. The sheets can be cut up and filed for reference in the same way as our regular Data Sheets prepared by Mr. A. B. Herrick.

President F. S. Hickok, of the association, has issued the following statement to the electrical public, on the subject:

The necessity for a standard system of electrical diagrams was first brought to the notice of the Chicago Electrical Association through the reading before that society, on the evening of January 15, 1897, of a paper on "Conventional Diagrams of Electrical Apparatus," written and delivered by Mr. D. W. C. Tanner. His active experience in matters pertaining to electrical patents especially fitted him for presenting such a subject. The discussion by the society at the time and the subsequent favorable criticism in the electrical papers, led the society to take steps toward publishing a series of selected diagrams more complete and comprehensive than any heretofore presented. Accordingly, a committee was appointed, with Mr. Tanner as chairman, and Thos. G. Grier, Kempster B. Miller, and S. G. McMeen (ex-officio), as fellow members. Mr. C. Wiler was subsequently chosen an additional member of that committee to take the place of Mr. Tanner, who, unfortunately, was obliged to resign. Mr. Grier was then appointed chairman, and the work has been pushed to completion. We anticipate that this report will furnish the possessor with a convenient, concise form of expressing his ideas in such a manner that they can hardly fail to be understood by any man having a fair knowledge of electrical principles. The ultimate result will be to make all electrical diagrams clear, and uniform in their representation of circuits and apparatus, and save much time and patience now lost in seeking in printed specifications for explanations of the various instruments shown.

The report of the Association Committee on Standard Diagrams is as follows:

The undersigned, your committee, appointed for the selection and preparation of conventional diagrams or symbols representing the various pieces of electrical apparatus in common use, respectfully submit the following report, together with the sheets of drawings annexed.

The time has arrived when the diagrammatic illustration of electrical apparatus should be reduced to an art. A uniform code should be established containing a diagram for each piece of apparatus, each diagram being at once simple, and so far as possible, suggestive of the particular piece of apparatus which it is designed to represent.

A decided improvement has been made in this direction during the last few years, yet at the present time the system is far from perfect. Its development has suffered through a lack of unity among the various makers of these diagrams.

The electrical divisions in the Patent Office have done more toward the development of this art than any other one agency. Often in a drawing accompanying an application for a patent, when a circle was used to represent a battery, and another circle exactly like it to represent a dynamo and still another, differing in no respect, representing the ground, the drawing was necessarily confusing, and was followed with difficulty, if at all. In such cases it has not been infrequent for the Patent Office to suggest to the inventor or his attorney that he submit a new drawing, using a certain adopted form or diagram to represent his battery and another to represent his dynamo, and so on. In this way, and with the well directed efforts of a number of patent attorneys, a great improvement has been made. These diagrams are to further assist in this direction.

It is well to state that no attempt at originality has been made in their selection. All available sources of information have been drawn from, and it has been the aim of this committee to adopt the best, regardless of whether they had been in common use or not. In deciding upon the diagram for any particular piece of apparatus, the question was considered from several standpoints. Simplicity always carried the greatest weight, and when several diagrams of apparently equal simplicity were to be chosen from, that one was taken which seemed most suggestive of the actual piece of apparatus represented.

The sheets of drawings attached to this report are, for the most part, self explanatory, and we think, need no comment. The representation of a dynamo or motor by a circle with two tangent lines showing the commutator and two brushes has long been in common use. This form of diagram may be used for any direct current machine in drawings where the form of the winding of the machine is either well understood or is not essential in the system to be represented. Similarly, the figure below it may be considered the generic alternator. Where it is necessary to show particularly the kind of a machine, the field coils may be added, as shown in the next three figures, which are so simple that they cannot be misunderstood by one accustomed to read electrical diagrams. The diagrams of the tri-phase dynamos or motors are shown by the characteristic windings of their armatures only. Where there is room for a doubt as to whether one of these diagrams represents a motor or a dynamo a letter M or G, as the case may be, will clearly distinguish them.

The diagram representing the motor generator will, perhaps, be subject to adverse criticism. In its adoption, good perspective is undoubtedly sacrificed for ease in drawing, but who can say that the diagram is not suggestive of what it is intended to represent?

The differentiation of the diagrams for the primary battery and for the storage battery from each other and from the ordinary diagram for a condenser, has been the subject of a good deal of thought. The primary battery diagram is the one in ordinary use. The storage battery diagram differs from it by having the plates connected in multiple, as in practice, and by the drawing of a square around it. This diagram will hardly be taken as representing a condenser, for the reason that the lines representing the plates of the battery are made thicker than those connecting the plates to the battery terminals.

The reason for not representing the ordinary hand magneto generator and the constantly driven generator by the same diagram, is that a need actually exists for a distinction between them. This is especially so in diagrams of telephone exchange systems where it is often difficult to distinguish between the hand generators at the subscribers' stations and the power generators at the central office.

The electrical measuring instruments need no comment, we think, owing to their extreme simplicity and the unmistakable evidence which they bear to their identity.

In the matter of single and double circuit breakers, many forms of diagrams were considered, each of which would probably have their advantages in certain places. This brings out well the fact that these diagrams must be taken merely as a guide, and not as a rigid code which must be absolutely followed. For instance, if it were essential that the circuit breaker should have an operating coil in each of the line wires, then it must be left to the designer or illustrator to make his own diagram for illustrating the particular case in hand.

On the simple telephone diagrams, but little comment is needed. It would be well if all would adopt the form of transmitter shown, from the fact that its construction is so extremely simple.

The listening and ringing key for telephone switchboards is a simple representation of one of these pieces of apparatus in common use. The remarks made concerning the cut-outs will apply with equal force to these.

Two diagrams for polarized bells have been shown. The one on the right hand side is preferable where its meaning cannot be mistaken. The almost universal adoption of this form of diagram has led this committee to show it here, although unless one is familiar with polarized bells in telephone work it must be said that it is not at all suggestive. In cases where it is thought best to be extremely explicit, or where the immediate context of the diagram does not suggest the use of a polarized bell, the diagram on the left is to be preferred.

The diagram for a polarized relay is, we believe, given here for the first time. By changing the plus and minus signs from one side of the armature to the other, it may be indicated that the relay will close on a minus current and open on a plus current, or vice versa. This is a feature which will be found at times very convenient.

The distinction between the ordinary resistance and inductive

resistance is both simple and suggestive, the presence of the core inside of the coil conveying to the mind the presence of a certain amount of self induction.

The use of two parallel zigzag lines for induction coils or transformers, lends itself readily to the distinction between the primary and secondary, between the step up and step down transformers, and, moreover, its construction is of such a simple nature, that it was chosen without hesitation by this committee from among dozens of other good diagrams for representing the same apparatus.

In the telegraph sounder the magnet coil has been represented in outline. In this connection it may be said that where it is not essential to know the nature of the winding or the direction of the convolutions, this same form of magnet might be adopted in any of the relays or annunciators used elsewhere in these diagrams.

The selection of a symbol for "a ground" which might be universally accepted is apparent. This custom of some artists of placing palm trees and grass, or the drawing of miniature landscapes surrounding their ground wire may add somewhat to the artistic effect, but certainly nothing to the clearness or merit of their work.

In conclusion it may be said that it is believed that where any particular piece of apparatus is to be presented for which no specific diagram is here found, it will be an easy matter for the person desiring such diagram to make it from the elements here shown.

The effort of your committee has been to group acceptable conventional diagrams in a convenient form, and in carrying out the instructions of the Chicago Electrical Association, we bring to a focus a matter which has been under discussion for several years.

By the official adoption of these diagrams by a recognized body of electrical men, a standard of uniformity is presented to the public. The committee realizes that this list is not complete, but hopes that it will be a nucleus of a uniform symbolic language among electricians.

From time to time, as suggestions may be offered, suitable additions can easily be made to our present selections. Respectfully submitted, Thos. G. Grier, Kempster B. Miller, C. Wiler, Committee.

Aluminum as a Rival of Copper and Brass for Electrical Conductors.

BY ALFRED E. HUNT, S. B.

(President of the Pittsburg Reduction Co.)

COPPER has been used for electrical conductors very largely in the past due to its comparatively high electrical conductivity, power of withstanding corrosion, ease of soldering and brazing, malleability, tensile strength and ductility. The exceptions in the past have been in telegraph wires of soft wrought iron and the brass, and any steel used in the parts of electrical machinery.

Aluminum has already been used successfully for these purposes and this article is written to call attention to its comparative merits as an electrical conductor.

The following facts regarding the metals, copper and aluminum, in bars, rods, and wire suitable for electrical conductors, need first to be considered:

Copper has a specific gravity of 8.93 (Authority—Association of Copper Manufacturers of the United States, 1893); an electrical conductivity, when pure and soft annealed reckoned at 100 in the Matthiessen Scale, but as ordinarily used in electrical conductors of about 98—97.61 (Authority—Prof. W. C. Roberts-Austen); a tensile strength of from 16,500 pounds per square inch in soft annealed pure copper (Authority—Carnegie's Hand Book) to 65,000 pounds per square inch in hard-drawn bars; and a selling price of about fourteen cents per pound in the United States, and an equivalent selling price of 130 marks per 100 kilograms in Germany, for wire, bars, and rods such as are used for electrical conductors.

Aluminum has a specific gravity of 2.68; an electrical conductivity (Commercially pure metal) of 63.00 (Authorities—Chas. F. Scott, of the Westinghouse Electric Company, and Prof. Jos. W. Richards, of Lehigh University); a tensile strength in pure soft wire of 26,000 pounds per square inch, and in hard-drawn rods or wire of 40,000 pounds per square inch.

Special Selling Price: The firm of Aron Hirsch & Son, of Halberstadt, Germany, are ready to sell aluminum conductors in the form of rods, bars, plates, and wire drawn to 2½ millimeters in diameter, at the special low rate of 280 marks per hundred kilograms, for large quantities of metal, and similarly The Pittsburg Reduction Company will sell rods, bars, plates, and wire drawn to No. 12 Brown & Sharpe gauge (eight hundredths of an inch diameter), in large special orders for electrical conductors, at the rate of twenty-nine cents per pound at their works in the United States.

These prices are special rates, below the regular prices for aluminum which these concerns have decided to make for electrical conductors alone, in order to favor the introduction of aluminum for this purpose and to overcome the handicap which aluminum has occasioned by its lower electrical conductivity than copper, in the matter of special low relative prices.

From these facts it is evident that:

1. Any given volume of copper is 8.93/2.68 or 3.332 times heavier than an equal volume of aluminum.

2. The equivalent price of fourteen cents per pound for copper for any length of any equivalent section of aluminum wire or bar, would be 14 cents times the factor 3.332, or 46.65 cents per pound. That is, one thousand feet of wire of, say, one-tenth inch diameter, would cost equally as much if bought of copper at 14 cents per pound, or aluminum at 46.65 cents per pound. Aluminum therefore sold at 29 cents per pound is only about 62 per cent. of the cost of copper at 14 cents per pound section for section.

3. Reckoning the copper conductor to have its maximum of 100 per cent. conductivity, and the aluminum to have a conductivity of 63 per cent. (which The Pittsburg Reduction Company are ready to guarantee for their special pure aluminum metal for electrical conductors), then for an equivalent electrical conductivity a given section of copper that can be placed at 100 should be increased in area in round numbers to 160 to give an equal conductivity.

4. Due to their relative specific gravities, the weight of the given equal length of the aluminum conductor with 160 sectional area will be only forty-eight per cent. of the weight of the copper conductor with sectional area of 100 having the same electrical conductivity.

$100 \times 8.93 = 893$, weight of the copper.
$160 \times 2.68 = 428.8$, weight of the aluminum.
$428.8/893 = 48$ per cent.

5. As to their relative cost for electrical conductors of equal conductivity, aluminum at twenty-nine cents per pound is the most economical conductor as compared with copper at fourteen cents per pound.

Taking as an illustration, an aluminum conductor to replace a copper wire of No. 10 B. & S. gauge (about one-tenth of an inch diameter), the aluminum wire of equal, in fact somewhat superior, electrical conductivity would be of No. 8 B. & S. gauge (slightly over one-eighth of an inch diameter).

The weight of a mile of No. 10 copper wire is 162.32 pounds; and its cost at 14 cents per pound would be equal to $22.72.

The weight of a mile of No. 8 aluminum wire would be 79.46 pounds and at 29 cents per pound would cost $23.04.

Forty-eight per cent. of the weight of the No. 10 copper wire, which will give equal electrical conductivity in aluminum wire, would only weigh 77.91 pounds; so that more accurately, $22.59 would be the cost of a mile of aluminum wire at 29 cents per pound to replace a mile of No. 10 copper wire at 14 cents per pound, costing $22.72.

6. The Continental requirements in tensile strength for soft copper wire, rods, and bars used as electrical conductors is 22 kilograms per square millimeter; the English requirement being similarly fourteen tons per square inch: and our American requirement is about its equivalent of 32,000 pounds per square inch.

Aluminum wire, rods, and bars will be furnished of 63 per cent. electrical conductivity, which will have an equal tensile strength per unit of area with the copper, and therefore with the electrical conductivity equivalent of 48 per cent. of the weight of the copper and sectional area of 160 against the area of the copper section 100, the tensile strength of the aluminum conductors will be as 100 for the copper is to 160 for the aluminum. This would mean if a square inch of copper conductor was used of, say, 32,000 pounds per square inch tensile strength, the equal conductivity area of 1.6 inches of aluminum would have a tensile strength of 51,200 pounds.

It has been already determined that with aerial lines, the snow and ice load is practically as heavy on lengths of small wire as

upon larger sections, so that no objection upon this score can probably be found to the use of the larger sections of aluminum wire.

Both on account of having only 48 per cent. of the weight and on account of having about 60 per cent. more strength, the aluminum conductor could be used in much longer spans between supports, and the number of expensive poles and insulators can be materially diminished. Properly drawn aluminum wire is as tough and will stand bending as severely without breaking as soft copper wire. The toughness of aluminum wire is, however, greatly modified by the care and skill used in manufacture. If it is drawn too severely through the dies or is not well annealed at the proper intervals in the drawing operation, it is finished much more brittle than when properly manipulated.

Hard-drawn copper wire, especially that in the smaller sections drawn through diamond dies, is furnished with a tensile strength of 65,000 pounds per square inch. What the maximum tensile strength of the best pure hard-drawn aluminum will reach under similar favorable conditions for developing the maximum tensile results, has not yet been determined, but from experiments already made it can quite surely be predicted that at least 50,000 pounds per square inch can be obtained, and perhaps even higher strength still.

Aluminum hardened with a few per cent. of alloying ingredients can be furnished in wire with a tensile strength far in excess of what can be obtained in pure aluminum. Experiments are now being made by The Pittsburg Reduction Company to determine just what alloy will furnish the maximum tensile strength, together with maximum electrical conductivity. From results already obtained, it can surely be predicted that an alloy of aluminum can be furnished which drawn into wire will have a tensile strength of at least 65,000 pounds per square inch and electrical conductivity of more than 50 in the Matthiessen scale. This material will rival hard-drawn copper wire and the silicon-bronze materials which are now in use, where maximum tensile strength together with good electrical conductivity are required.

The power of withstanding corrosion is greatly in favor of aluminum as an electrical conductor over copper. Copper does not change in dry air, but in moist air it becomes covered with a green layer of basic carbonate of copper, which itself has a corroding action and does not coat and protect the underlying copper from further corrosion. Ammonia in contact with copper absorbs oxygen and the copper dissolved in consequence of the formation of a soluble cupric-oxide and ammonia. This action is especially a source of trouble where copper wire is used in connecting rail joints in the tracks of electrical railroads where the ground is often subjected to ammoniacal solutions.

Aluminum similarly is not acted upon in dry air and the corrosion in moist air is of the oxide of aluminum, alumina, a harmless salt which forms an impenetrable coating on the metal and protects it from further corrosion to a considerable extent. Ammonia solutions act on aluminum only upon the surface, attacking it and leaving behind a more resisting surface coating of a brown color containing silicon, which resists corrosion from dilute mineral acids and dilute solutions of organic acids as well as moist and dry air. Subject to sulphur gases such as locomotive flue gases, aluminum withstands corrosion better than copper.

If kept free from galvanic action with any other metals electro-negative to itself, aluminum is far less easily corroded than copper.

The difficulty of soldering or brazing aluminum is the chief drawback to its use as an electrical conductor. Aluminum can be soldered strongly, but it is a more difficult and slow operation at best as compared with copper, and there is much more rapid weakening of the soldered joint due to galvanic action between aluminum and the metals of the solder than with the less electro-positive metal, copper.

In many places the aluminum can be first coated with copper and the soldering or brazing operation made on the copper surfaces thus formed.

Several forms of joints have been successfully used to avoid the necessity of soldering; the best forms being to use thin aluminum sheets to wrap the joints and to twist or otherwise bind with the aluminum bars or wires to be joined. These wrapped and twisted joints with aluminum sheets can be left smooth on the outside when desired, can be made much stronger than the body of the conductors, and are really a more serviceable job than soldered or brazed work in many cases with copper. One very practical way of making joints of aluminum wire is to roll the thin aluminum sheet of about six inches width into two cylinders from opposite edges of the sheet. These double cylinders are very cheaply made on mandrels in a lathe. The ends of the wires to be joined are inserted in these cylinders from opposite ends and both the wire and sheet twisted with pliers until a firm joint is secured, much stronger than the body of the wire. The joint can readily be made impervious to the air and moisture.

The C. McIntire Company, of Newark, N. J., have a patented joint which is made very much along the lines of this joint. Information regarding their patented form of joint can be obtained by correspondence with them as above. Also The American Electric Fuse Company, Chicago, Ill., make a very satisfactory joint.

Another disadvantage which handicaps aluminum in special uses for electrical conductors will be where the material has to be insulated that the cost of insulation will be approximately one-third greater for the larger section required in aluminum over the cost for the smaller section of copper required for the given conductors; and where aluminum is to economically compete for insulated conductors, the price of the aluminum will have to be further reduced to meet this contingency.

Aluminum is soon to be placed in an extensive line of conductors where this added extra cost of insulation will be determined by actual fabrication; The Pittsburg Reduction Company in this particular case agreeing to pay the added costs, in order that actual experience may be gained as to their relative amounts.

There are certain places where aluminum will be at a disadvantage over the smaller section of equal conductivity of copper, in ducts or conduits where space is a considerable item. In such cases, the use of aluminum would necessarily be prevented.

An ample field for the employment of aluminum for some time to come, however, seems open at the present time for bare transmission lines, especially for high-potential long-distance work and for long-distance telephone lines and for rapid transmission telegraph lines.

Aluminum next to gold is the most malleable of all the metals and is much more malleable than copper.

Aluminum in ductility stands next to copper and is easily drawn into all sections that are furnished in copper for electrical conductors.

Aluminum can be furnished fully as uniform in its composition as copper.

The metallurgy of copper is comparatively complicated, owing to the difficulty of converting its ores into the oxide free from impurities. In most of the copper ores used, sulphur, lead, and iron are contained as well as small quantities of other elements, as arsenic and antimony. All of these elements in metallic copper very materially lower its electrical conductivity. The native pure copper of the Lake Superior region enjoys the preference, due to its uniformity and freedom from impurities, for many purposes, but for electrical conductors the electrolytic copper is most used.

Aluminum can now be furnished rivaling for electrical conductors at least 99.50 per cent. pure, it is granted not as yet in purity of composition the best electrolytic copper used for the purpose of electrical conductors. When as pure a metal is obtainable undoubtedly it will more nearly rival copper in electrical conductivity section for section.

Aluminum has been already in successful operation as an electrical conductor for some time. The first use in a large way was with the conductors for the electric current at the Niagara Falls Works of the Pittsburg Reduction Company, where it has been used since the year 1895; the currents were of several thousand horse-power each and of very large volume and comparatively low voltage. Both in conducting power, freedom from heating effects, power of withstanding corrosion, ease of making, wear, and efficiency of joints, the aluminum conductors have given better results than copper used for the same purpose.

In the Chicago Stock Yards, a mile of aluminum wire of No. 11 gauge has now been in use for some time, upon a telephone line that has been badly corroded out in copper wire, due to its being frequently subjected to sulphur gases from passing locomotives. The aluminum line is giving good satisfaction and is withstanding corrosion much better than did the original copper wire subjected to the same influence.

If the theory be true that the passage of high voltage alter-

nating currents of great frequency is largely upon or near the surface of the conductors only or mainly, then the larger section of the proposed aluminum conductors will make them especially adaptable for such currents.

On telephone lines, it has already been determined that as good sound transmission is obtained, with aluminum of equal section as with copper, in ordinary lengths of less than ten miles of wire. No comparative results, however, have as yet been determined on long distance telephone transmission; but the evidence would seem to point that a much less section than 160 of aluminum to 100 of copper will give equally good results.

Aluminum is now being used to replace brass very considerably in the arts, as it is sold in the open market at rates which make it ten per cent. cheaper, section for section, than brass.

For electrical purposes, the metal can be advantageously used to replace brass in a good many ways. Commercially pure aluminum as furnished to-day contains less iron than does commercial brass, and is therefore more non-magnetic than brass.

The electrical conductivity of aluminum is far superior, section for section, to brass. Almost every electrical apparatus of present construction in which an iron core—usually a laminated iron core—is used, in motors, generators, or transforming machinery, has spaces for ventilation, and the spacing is made by the means of drawn bars, flat rods or angles or tee shape pieces. Brass has been almost invariably used for this purpose in the past—probably on account of its non-magnetic properties as compared with iron or steel. Drawn aluminum sections can be furnished at a price which is ten per cent. cheaper than brass, section for section; and on account of the lightness of aluminum, it can be advantageously used.

Where a low electrical conductivity is desirable, as in parts that are moved in a magnetic field, to prevent the occurrence of eddy-currents, aluminum can be alloyed with zinc and other metals that will lower its electrical conductivity to the desired point.

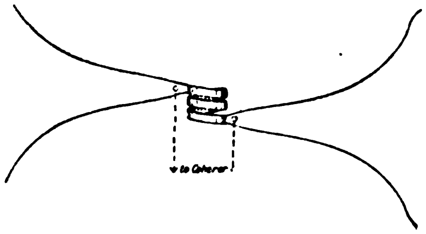
A Doctor's Telephone Lines.

Discussing a bill to tax telephone lines, Mr. Dougherty said recently in the Illinois Legislature: "Over here in Hancock County there is a wealthy doctor who has been building telephone lines. He's gradually extended them until he now has quite a system. Oh, yes, it's a great convenience, but nobody on his lines dares to get sick unless he or she employs this particular doctor. He won't allow any other doctor in the county to be called up through his telephone system."

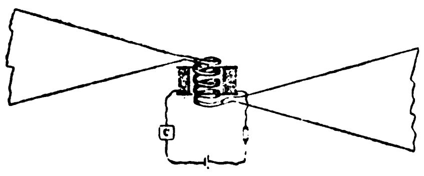
TELEPHONY AND TELEGRAPHY

Prof. Lodge on Electric Signalling Without Connecting Wires.

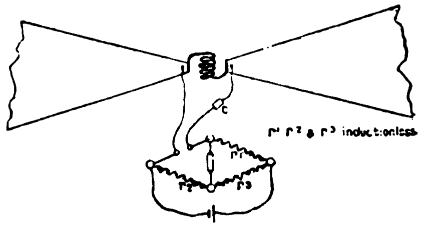
AT a meeting of the Physical Society, held in, London, January 21, 1898, Professor Oliver J. Lodge gave the following interesting communication concerning his work on "Electric Signalling Without Connecting Wires." The illustrations given herewith were made from sketches sent to "The Electrical Engineer," London, by Dr. Oliver Lodge, and are not referred to in the text of the official report.



A SYNTONISED RECEIVER.

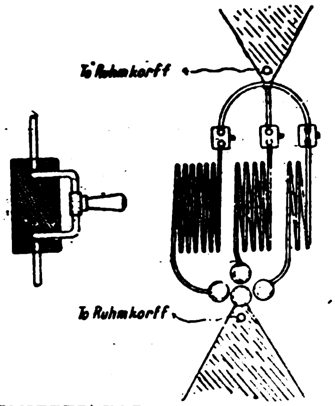


Sketch showing a mode of stimulating coherer by means of currents induced in an outer coil with the simplest connections to coherer.

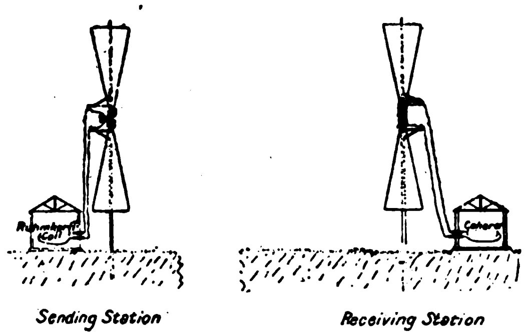


WHEATSTONE BRIDGE CONNECTIONS.

From the nature of the oscillatory disturbances emanating from any of the customary forms of Hertz vibrator, syntony has hitherto been only very partially available as a means for discriminating between receivers. There is, in fact, so rapid a decrease in the amplitude of the vibrations that almost any receiver can respond to some extent. Discrimination by syntony is possible with magnetic systems of space telegraphy where the magnetic energy much exceeds the electric—i. e., as between two separated inductive coils—and by the use of such coils, appropriately applied, the author has been able to attain fair syntony even with true Hertz waves—i.e., he has constructed spark-



EMITTER FOR THREE DIFFERENT RECEIVING STATIONS.
(The connections are plugged up according to station required.)

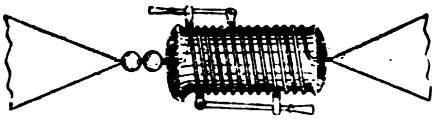


A PAIR OF LONG-DISTANCE SIGNALING STATIONS WITH SYNTONISED EMITTER AND RECEIVER.
(The coils connecting the capacity areas are diagramatically shown.)

A LONG-DISTANCE SENDING AND RECEIVING STATION.
(The insulated metal roof is used as the capacity area, with all its parts well connected up to discharging rod.)

gap oscillators, with sufficient persistence of vibration, and syntonized resonators. The "coherer" principle can be applied to either a purely magnetic or to the Hertzian system. It was first used by Prof. Lodge in devising lightning guards, and afterwards in his magnetic system of telegraphy by inductive circuits, each in series with a Leyden jar, a pair of knobs in near contact, or other overflow gap, being provided in the receiving apparatus. This was the first meaning of a "coherer" in the electrical sense as used by Prof. Lodge: it referred to a single contact between two metal knobs. The term has since been extended by others to the filings tube of M. Branly, and some confusion has arisen, for M. Branly does not consider that simple coherence and break explain fully the behavior of his instrument. Prof. Lodge is disposed to agree, for he finds that the resistance of almost any form of coherer varies in rough proportion to the received impulses, and that there are other peculiarities (to be mentioned later); he is therefore inclined to think that the action cannot, after all, be entirely explained as due to mere "welding," but

that there is something more to be learnt about it. The sensitiveness of a coherer depends upon the number of loose contacts; it is a maximum for a single contact—i. e., for a needle point lightly touching a steel spring. With this sensitive coherer, hardly any "tapping back" is required for decoherence, but it wants delicate treatment when properly adjusted, and the greatest current through it should not approach a milliampere. On the other hand, a Branly tube rather improves under rough treatment. In such a tube the author prefers to use iron filings in the best possible vacuum; brass, too, is very good, but rather less easy to manage. Aluminum is thoroughly bad, and gold, for an opposite reason, will not work—its surface is too clean. Points, or small surfaces for making contact with the filings, are better than large surfaces. The usual method of connecting the coherer across the gap of an ordinary Hertz receiver, in parallel with the telegraph instrument and battery, has the unavoidable objection that it shunts away part of the received oscillations. With the syntonic receiver of Prof. Lodge, which contains no gap but a closed wire coil instead, the difficulty no longer exists, for the coherer can now be in series with the detecting instrument, and in so far as these obstruct the oscillations they may be shunted out in various ways, as the author describes. The main feature of his new syntonized vibrators is this self-inductance coil, whose function it is to prolong the duration of the oscillations, and thereby to render syntony possible. Although such a coil acts disadvantageously in so far as it possesses resistance, the resistance does not increase so fast as the self-induction. The coil should consist of thick copper of highest conductivity, and it should have maximum inductance for given resistance. For similar reasons the capacity areas should also be of highest conductivity; their dimensions should increase outwards from the spark-gap, as triangles. The receiver must



A METHOD OF TUNING A RECEIVER BY MEANS OF A HEDGEHOG CHOKING COIL.

have no gap; it should be accurately bridged over when a transmitter is used as receiver. The limit of speed of response depends upon the telegraphic instrument. Dr. Muirhead adapted a siphon recorder to the purpose, because it is one of the quickest responders. He arranged it so that it could be used with intermittent currents direct. Under these intermittent impulses the siphon trembles, and instead of the ordinary siphon signals the slip is marked with dots and dashes. Constant mechanical tremor is usually employed by decoherence, but the author finds that decoherence can be brought about by electrical means, without any mechanical tremor, by connecting the coherer momentarily to a circuit less effective as a collector than that of the proper capacity areas of the syntonized receiver. The battery and galvanometer detector circuit may be used for this purpose; the coherer being momentarily connected to it, and while so connected, letting it experience an impulse from a distance. Prof. Lodge has designed a revolving commutator, by means of which the coherer can be rapidly changed over from the resonating circuit to the instrument circuit, and finally to the "tapping-back" apparatus. A coherer is more sensitive when thus isolated and exposed to the full influence of the received oscillations. The subsequent detection of the effect by altered connections is very convenient for laboratory measurements. A diagram of a series of plotted measurements showed that the resistance of an undisturbed filings tube is approximately a direct function of the intensity of the received stimulus, whether successive stimuli increased or decreased in strength. This electrical process of "tapping back" is to be depended upon, but the process long continued fatigues the tube until a mechanical shake is employed to restore it. Large-size apparatus made by Dr. Muirhead for actual distant syntonic work was exhibited, and means were shown for protecting and isolating the coherer when its receiving areas were being used as emitters; also a switch used for changing at one moment all the connections from "sending" to "receiving."

The discussion which followed was participated in by Prof. Threlfall, Mr. Rutherford, Mr. Campbell-Swinton, Prof. Herschel and Dr. S. P. Thompson, the last of whom exhibited a Tesla oscillator. This apparatus Prof. Lodge said would work quite well with as low a voltage as 10 volts and in answer to a question by Prof. Herschel whether the Tesla oscillator was suitable for work with Röntgen rays, Dr. Thompson congratulated Mr. Tesla upon the perfect working and compactness of his invention, and stated that the present form was not suited for Röntgen ray experiments with the ordinary focussing tubes, but Mr. Tesla had designed a special tube which gave most excellent results with the coil.

Drug Store Telephony in Detroit.

The Michigan Telephone Company has inaugurated a new plan of pay stations, or, rather, an extension of the old system, as many people who have been in the habit of using drug store telephones have found out. The scheme is this: A druggist, for instance, is offered free telephone service for himself, if he will allow the company to place in his store a telephone with a nickel-in-the-slot attachment, so that all transient users of the telephone will be compelled to pay for the service. The drug store can be called up by any of its customers, and there will be no charge, but the druggist himself is limited to free service with wholesale houses, the hospitals, police and health boards, and all physicians. Many druggists have already installed the new system and report that so far it has worked satisfactorily.

A French Cable to Honolulu.

A special dispatch from San Francisco says: Advices received from Honolulu by the steamer Marchesa state that the French cruiser Duguay Trouin arrived there February 3, her commander bearing a letter from the French Governor of Tahiti, informing the Hawaiian Government that the French cable from Tahiti to Honolulu was to be laid at once, and in future the Messageries line would call at Honolulu. This letter caused the utmost consternation in government circles, and a dispatch was sent at once to Washington asking for instruction and advice.

Opposition to Bell Telephone.

William L. Holmes, who is one of the organizers of the Union Telephone Company, just incorporated in Maine with a capital of $10,000,000, and who is prominently associated with the Detroit Telephone Company, says: "The new concern is only a forerunner of an opposition to the Bell telephone monopoly, more gigantic than anything ever before attempted in that line."

OBITUARY

J. H. Rhotehamel.

It is with extreme regret that we note the death of Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Company, of St. Louis. At the beginning of the month he went from St. Louis to Hot Springs, Ark., for rest and treatment, taking his family with him. After commencing his regimen, he became seriously ill, but no alarm was felt as to results. Other doctors were called in later, and his family were advised to return home with him. He reached St. Louis on the Wednesday, and on Thursday died of congestion of the brain.

Mr. Rothehamel was a fine type of the modern, progressive business men of St. Louis and of the younger commercial talent enlisted by the electrical industry. He made himself very prominent by his fight in behalf of the Goebel lamp claims, in which he believed firmly and which he supported with a generous array of legal talent. As to the Columbia lamp, he pushed that to a front place by his skill in factory management; and he won for the Columbia products a high esteem everywhere. Of late he had been an active and loyal member of the lamp "combination" recognizing patents and sustaining prices. His personality was agreeable, and he made himself generally liked, not least by those whom he had to oppose.

The funeral services took place on February 19. We beg to add our own regrets to those of all who knew Mr. Rhotehamel, and to offer the family our condolence.

Lord Sackville Arthur Cecil.

Lord Sackville Arthur Cecil (half brother to the Marquis of Salisbury) died recently at Holwood, Kent, England, after an illness of several weeks. In early life Lord Cecil showed signs of scientific tastes and after his graduation from Cambridge was engaged in the carriage department of the Great Northern Railway. He subsequently joined the traffic department of the Great Eastern Railway, and showed a lively appreciation of the details of the working of a great railway system. From 1878 to 1880 he held the post of assistant general manager of the line. In 1880 he was appointed general manager of the Metropolitan District Railway, and continued in that post for five years.

He then became associated with submarine telegraphy, and at the time of his death was a director of the Eastern, the Brazilian Submarine, and the Pacific and European Telegraph Companies, and of the Globe Telegraph and Trust Company.

He was a man of the simplest habits, of unvarying courtesy to all, of the keenest intelligence, doing all he undertook with the utmost thoroughness and conscientiousness. He will be greatly missed and widely regretted.

Effect of Roentgen Rays on Vegetable Life.

Experiments on the action of Röntgen rays on vegetable life have hitherto mostly led to negative results; but Signor G. Tolomei, writing in the "Atti dei Lincei," is led to the conclusion that their action is identical with that of light. On exposing to the action of Röntgen rays branches of Elodea canadensis immersed in water charged with carbonic anhydride, evolution of bubbles took place as in the presence of sunshine or electric or magnesium light. The same similarity was observed in the effects on the lower vegetable forms, both Röntgen rays and light causing retardation in the absorption of oxygen by Mycoderma aceti, and in the evolution of carbonic anhydride by Saccharomyces. Again, in their action on Bacillus anthracis the Röntgen rays behave in the same way as sunshine, but in a minor degree; when a gelatine film was exposed for twenty-four hours to the radiations from a Crookes' tube, with the interposition of a zinc screen having an X-shaped aperture, the letter appeared transparent on an opaque background. That the action was due to destruction of the germs, and not to the generation of any toxic quality in the agar, was proved thus: when a sterilized film was partially exposed to the rays, and subsequently brought into contact with a stratum of dried spores, the spores began to germinate all over the film; but when the stratum of spores was exposed to the rays, the screen with the letter X being interposed, and the film subsequently brought into contact with them, only those spores which had been protected from the Röntgen rays developed, and the letter X was distinctly seen. Signor Tolomei attributes the previous failure to obtain such effects to the short duration of the exposures.

PERSONAL

MR. FRANK J. SPRAGUE, formerly a lieutenant in the U. S. Navy, has tendered his services to the Navy Department, asking to be assigned to active duty should the occasion arise.

MR. F. VON HEFNER-ALTENECK has been given an honorary doctorate by the University of Munich, on account of his services to the theory of electricity and to the modern development of electrotechnics. The new doctor is well known as the inventor of many improvements in the design and construction of dynamos in the early days of electric lighting. He also invented the Hefner or amylacetate lamp, which is now charge a case full of beautiful silverware.

MR. W. J. MARTIN, retiring manager of the Western Union Company's main office at San Francisco, has received from the employees of the operating and other departments under his charge a case full of beautiful silverware.

MR. C. F. MUNDER, treasurer and general manager of the Davis Electrical Works, Springfield, Mass., sailed on the St. Paul on Wednesday, the 16th, for London and Paris. Mr. Munder contemplates establishing agencies abroad for the sale of his company's product.

A Brilliant Telegraph Tournament for the Electrical Exhibition.

WE have received from the Exhibition management the subjoined excellent article from the "Telegraph Age," giving some details and data as to the great telegraph tournament that will be held at the Madison Square Garden. It is said that the tournament will take place during the second week of May:

As already announced, the New York Electrical Society, during the month of May, will give, under its auspices, an electrical exhibition in Madison Square Garden, New York. In connection therewith, an auxiliary and educational committee has been formed to take general charge of exhibition matters other than commercial, and it has been decided that one or more evenings during the exhibition shall be set apart for a telegraph tournament, and we take great pleasure in advising the "crack" senders and receivers of America to tune up their keys and sounders and get on their best gait, for there will certainly be a "hot time" in Madison Square Garden some time during the month mentioned.

It goes without saying that this will be the greatest telegraph tournament ever held in the world. The committee has secured the services of Mr. Fred Catlin, who is the most competent gentleman to successfully conduct an affair of this magnitude. Mr. Catlin is justly termed "the father of telegraph tournaments," for, with one exception, he has managed every telegraphic contest which has been held in New York since 1866, when Mr. Pat Burns, of Boston, won the gold key, including the Bunnell key contest, in the Western Union Building in 1884, which was won by Mr. W. L. Waugh; the Victor key contest, in the United Press rooms in 1885, won by Mr. J. W. Roloson, and the great national fast-sending tournament at Hardman Hall in 1890.

These affairs were not conceived or carried out by Mr. Catlin with a view to pecuniary gain, but through his interest in the matter of bringing the art of telegraphic manipulation up to its highest point. We have heard him say he would prefer hearing the music of a Roloson's, Gibson's, Kihm's, or Frank Catlin's transmission to listening to the grandest of operas, and in this respect he is not unlike many whom we have met.

Mr. James D. Reid, the "father of the telegraph" and well-known to every operator the world over, has consented to act as chairman of the board of judges. Mr. Reid's appearance on such an occasion as this will be hailed with positive delight by the fraternity at large, and no doubt his presence will encourage operators from all sections of the country to visit New York to capture some of the numerous prizes.

Mr. J. B. Taltavall, a member of the auxiliary and educational committee, will also assist in looking after the interests of the telegraph boys.

In conversation with Mr. Fred Catlin a few days ago, he remarked that he also was determined that the telegraph tournament should be a success in every particular and that it shall surpass any previous affair of its kind. The management will spare no efforts to make this feature of the exhibition a most attractive and successful one. The prizes will be liberal and the contests numerous, and there will be ample opportunity for the young talent which has come into the field since the last tournament of five years ago to show of what stuff it is composed. "It is my opinion," said Mr. Catlin, "that the records will be smashed by more than one.

"The exact dates of the contests have not yet been determined. If it is found that one afternoon and evening are not sufficient

time for running off the various classes, more time will be allotted.

"Handsome medals or badges will be awarded to the winners, to which will be added liberal cash prizes.

"The prevailing opinion, in which I concur, is that the same matter should be used in every telegraphic contest for the purpose of comparison. It is just as necessary and important in this work as it is that the mile race track should measure exactly 5,280 feet.

"At the tournament of 1893 the top records were:

	Minutes.	Words.	
Kihm	5	248	perfect.
Catlin	5	248	"
Gibson	5	246	2 errors.
Mecredy	5	249	14 "
White	5	248	10 "

"The matter used in the contest of '93 was entirely different from that used in '90, so exact comparisons of work done can not be made. The transmission of Mr. Pollock in the tournament of 1890, while it was the most remarkable ever listened to in a public contest in the matter of speed, would not have been acceptable under the conditions of the contest of 1893, owing to the frequency of imperfect characters. It is possible for a first-class operator to read easily perfect transmission up to a speed of about sixty words per minute, a speed not likely to ever be reached by hand transmission. The value of transmission is lost when it is not rendered clear and accurate, and judges will so render their decisions."

Mr. Catlin will as soon as possible issue a circular for the information of operators desiring to participate in the contests. This circular will contain records of past tournaments, conditions to govern the coming affair, classifications, date of closing of entries, the matter to be used in transmission, and other things which may be suggested as being of interest to the fraternity.

Of course, one of the features of the tournament will be a typewriter receiving contest, which it is expected will be participated in by the friends of every known typewriter on the market.

The most liberal prizes will be awarded to the victors, and we can assure those who wish to participate in this tournament, whether residents of New York, Chicago or San Francisco, that they will be well taken care of and repaid for their trouble if they will visit New York and take part in this greatest of all telegraph contests.

SOCIETY & CLUB NOTES

American Institute of Electrical Engineers.

The 122d meeting of the Institute was held at 12 West Thirty-first street, New York City, on Wednesday, February 23, 1898, at 8 o'clock p. m. A paper was presented by Mr. Charles P. Steinmetz, of Schenectady, N. Y., on the "Single Phase Induction Motor."

Anniversary of the Institution of Junior Engineers.

THE thirteenth anniversary of the Institution of Junior Engineers was held on Saturday, Jan. 29, 1898, at the Westminster Palace Hotel, London.

After the loyal toasts had been honored, Mr. Alexander Siemens gave the toast, "British Railways." He could not, he said, help thinking that the management and development of English railways had a very direct bearing on the question which gave rise to the late engineering dispute.

Prof. Perry proposed the toast of "A Realized Teaching University for London." He said he would have liked to have talked about railways and all that, but he didn't know anything about it. There was one thing he would like to know, however, and that was when were they going to take cycles at a cheap rate.

Prof. S. P. Thompson, in responding, said a great change was coming over the teaching of science. It used to be thought that science could only be learned from books, but now it was coming to be understood that the only way to learn it was by working in the laboratory. Mr. Hiram S. Maxim said only one or two miles per hour more than 60 miles per hour could now be got out of an ordinary locomotive whatever improvements were effected. He thought that if electricity were introduced on any of the lines now in use, they might possibly get up to 100 miles per hour. The finest coal had to be used in express locomotives, but with electricity they could burn coal costing half the price. Electricity had been brought so much into use in the United States that it had lowered the price of horses one-half; in fact, it was said that at one place horses were being killed and potted to send to France.

Mr. Aspinall said he thought Americans worked harder, and turned out more work than Englishmen. The English had very carefully constructed machine tools, but the men did not get half as much work out of them as they might.

Members Elected to the New York Electrical Society.

At the 185th meeting of the New York Electrical Society, February 11, the following members were elected: Prof. Robert Ogden Doremus, Max Loewenthal, James H. Bates, Raymond W. Charles, W. L. Hedenberg, Frank Martin, F. A. Pattison, Geo. C. Hoffman, Thorburn Reid, Robert Lozier, Prof. Sidney H. Short, Geo. Sommer, John J. Swann, Meyer S. Blumberg, Frederick W. Young, Wesley Gray Gilmour, Edwin Adelbert Howe, H. F. Sanville.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At a regular meeting of the society held in its lecture room on Tuesday, Feb. 15, a paper was read by Mr. J. N. Chester on "The Elevated Condenser for Central Condensing Plants" before the Chemical Section; on Thursday, Feb. 17, Mr. J. O. Handy read a paper on "The Municipal Laboratories of Hamburg, Germany." Mr. Reginald A. Fessenden is the secretary of the society, and the society's house is located at 410 Penn avenue, Pittsburg, Pa.

LEGAL NOTES

The Home Telephone Co. of Mobile, Enjoined on the Scribner Patent No. 330,061.

IN the early part of last year suit was brought by the Western Electric Company against the Home Telephone Company, of Mobile, Ala., for infringement of a Scribner patent. The testimony given in the case as well as the points at issue were fully discussed in our issue of July 22, 1897. The patent in suit was that of C. E. Scribner, entitled "Multiple Switchboards," No. 330,061, November 10, 1885. The patent relates to multiple switchboard signals, designed to enable the operators at the different boards to test what lines are in use, while the circuits are so arranged that any two lines may be connected together upon any one of the boards without including in their circuit the resistance of the contact points of the switches.

The complainants alleged that claims 2, 4 and 6 of the patent were infringed. These claims read as follows:

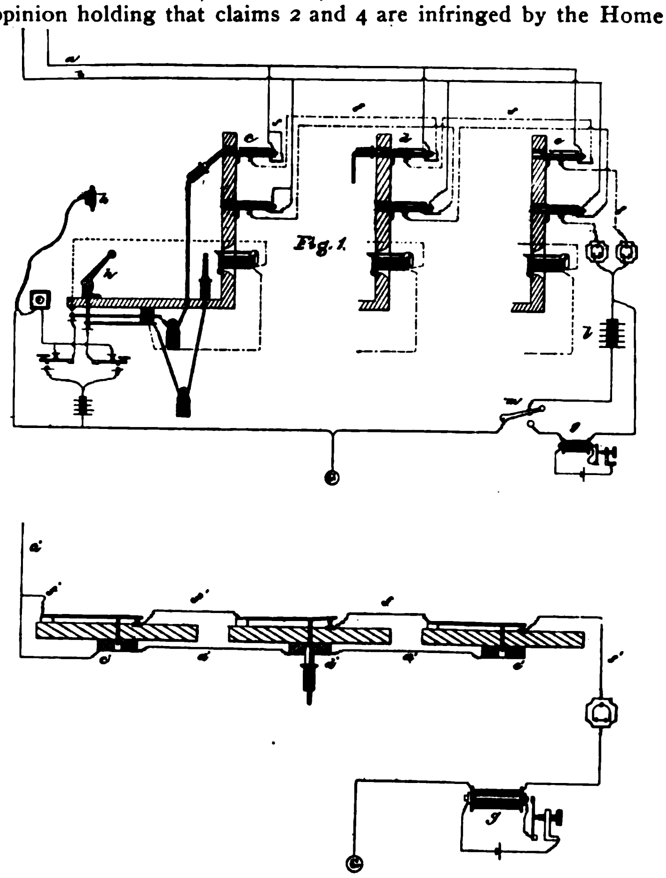
"Claim 2.—At a telephone exchange central office the combination of multiple switchboards with telephone lines, each permanently connected to a metallic portion of its switch upon each board, each telephone line being also connected through the contact points of its switches and to ground, and means whereby the circuit of the branch wire of any given line is opened when a connection is made with the line at any board whereby any two lines may be connected together upon either of the boards without including in their circuits the contact points of either of their switches."

Claim 4.—The combination, with a telephone line provided at each switchboard of a multiple system with a connecting bolt or switch of a portion of said line connected through an annunciator to ground and means for breaking said line when a connection is made with the telephone line at either one of its

bolts or switches substantially as and for the purpose specified."

"Claim 6.—In a multiple switchboard system, a telephone line provided with a spring jack at each switchboard of the system, said spring jacks being provided with insulated metallic frames, and said telephone line being connected directly to each of said insulated frames, and also through an annunciator to ground through the springs and contact points of said spring jacks, whereby a connection may be made direct to the telephone line at any board at the same time the portion of said line containing the annunciator is broken, substantially as set forth."

Judge Toulmin, before whom the case was argued in the U. S. Circuit Court, at Mobile, has handed down an elaborate opinion holding that claims 2 and 4 are infringed by the Home



FIGS. 1 AND 2 OF SCRIBNER'S PATENT NO. 330,061.

Telephone Company, but that claim 6 has not been shown to be infringed.

No decree was issued against Adam Glass and Alfred S. Lyons, officers of the Home Telephone Company, as it was not shown that they had derived any individual profit from the patent sued on.

A decree was entered, accordingly, for an injunction and an accounting of the profits and damages with respect to claims 2 and 4, the injunction not to be operative until 60 days after entry of decree, so as to avoid inconvenience to the public.

A Kentucky Law Forbidding Consolidations.

The Kentucky House has passed a bill to forbid any railroad, telegraph, telephone, bridge, or common carrier company to consolidate its stock, franchises, or property, or to pool its earnings with a parallel or competing line, or to acquire such line. It also forbids any combination between common carriers by which the earnings of the one doing the carrying are to be shared by the other not doing the carrying.

THE SPRAGUE ELECTRIC COMPANY has offered $1,000 reward for information leading to the detection and conviction of the thief who stole certain papers from the desk of vice-president Frank J. Sprague, in the company's offices at the Commercial Cable Building, Broad street. It is said that the papers related to recent railway inventions and calculations.

MR. C. C. LONG writes: "Allow me to express my appreciation of the way in which The Electrical Engineer is being conducted."

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents issued February 8, 1898.

Alarms and Signals:—

AUTOMATIC ELECTRIC FIRE ALARM. W. A. Guthrie, Durham, N. C., 598,508. Filed July 7, 1897. Comprises a push button containing a spring contact normally closed but held open by an extension of easily fusible metal.

TESTING APPARATUS FOR ELECTRIC CIRCUITS. E. and F. W. Heymann, Boston, Mass., 598,517. Filed February 26, 1897. Adapted for telephone or signal systems; details of construction.

ELECTRIC CALL BOX SYSTEM. W. T. Budds, Charleston, S. C., 598,853. Filed August 23, 1897. Provides a single wire open main circuit having a single wire connection with each call box, the circuit being completed through the ground.

Batteries, Primary:—

PRIMARY BATTERY CELL. F. H. Brown, Chicago, Ill., 598,556. Filed December 9, 1895. Comprises a negative element, composed of an agglomerate of black oxid of manganese and plumbago, and having superimposed layer of carbon, sealed with an insulating material, and having a conductor embedded therein, and a positive element.

Conductors, Conduits and Insulators:—

JUNCTION BOX FOR ELECTRIC CONDUCTORS. T. J. Close, Philadelphia, Pa., 598,498. Filed May 26, 1897. Embodies a lid with a series of openings registering with the flange-openings and bolts for openings with locking nuts.

Dynamos and Motors:—

CONSTRUCTION OF DYNAMO ELECTRIC MACHINERY. A Soames, London, Eng., 598,540. Filed December 6, 1897. The bearings for the armature shaft are secured to the frame by castings of type metal.

ALTERNATING CURRENT DYNAMO. W. B. Esson, London, Eng., 598,657. Filed April 21, 1896. Employs an armature core-piece provided with orifices for embedding the coil and formed with additional orifices.

Lamps and Appurtenances:—

ELECTRIC ARC LAMPS. S. I. Crain, Cincinnati, Ohio, 598,697. Filed July 24, 1897. Employs a pair of pivoted arms carrying rollers adapted to engage with the upper carbon near its point of support, and electrical connection between the rollers and the main.

INCANDESCENT ELECTRIC LAMP AND PROCESS OF MAKING SAME. J. C. Fish, Shelby, Ohio, 598,726. Filed August 3, 1897. Embodies a mount composed of a pair of tubes rigidly braced together, a plate fused to the lamp globe and to which the ends of the mount are fused, and through which the leading-in wires contained in the mount project.

Miscellaneous:—

PROCESS OF MANUFACTURING GRAPHITE. H. H. Wing, Buffalo, N. Y., 598,549. Filed December 14, 1896. Consists in passing an electrical current through carbonaceous material, whereby the heat thus produced converts part of the carbon into graphite, and then separating the unconverted carbon from the graphite.

ELECTRIC HEATER. J. F. McElroy, Albany, N. Y., 598,638. Filed March 24, 1894. Adapted for use in drying barrels, casks, etc.

ELECTRIC RADIATOR. J. F. McElroy, Albany, N. Y., 598,639. Filed January 25, 1895. For street railway cars; details of construction.

ELECTRIC HEATER. J. F. McElroy, Albany, N. Y., 598,640. Filed April 6, 1895. Comprises two over-lapping plates adapted to slide relative to each other and provided with insulating edges, means for connecting the plates together, springs arranged between the plates tending to force them apart, and a resistance wire wound around the plates.

MANUFACTURE OF CARBONS. C. L. Saunders, Cleveland, Ohio, 598,646. Filed June 3, 1897. Consists in mingling the carbonaceous material with a binder in liquid form, grinding the mixture while wet and distilling off the volatile elements of the mixture.

BENT ROTATABLE GASTROSCOPE. G. E. Kelling, Dresden, Germany, 598,787. Filed March 20, 1897. Comprises a casing, having a rotatable head section containing an illuminating device.

VELOCIPEDE. G. J. Scott, Philadelphia, Pa., 598,819. Filed May 4, 1897. Employs a series wound dynamo driven from the crank shaft to supply current for a motor geared to one of the driving wheels.

Railways and Appliances:—

TROLLEY HEAD. H. W. Smith, Somerville, Mass., 598,580. Filed June 10, 1897. A trolley head having an annular enlargement having a groove therein, an endless ring closed into the groove so as to enclose the head more than half of the circumference, the remainder of the ring being bent outward to form an eye for the attachment of the trolley rope.

ELECTRIC STREET CAR TROLLEY. J. T. Himmeger, La Rue, Ohio, 598,661. Filed Oct. 20, 1896. Means whereby the pole can be shifted by the motorman without leaving the platform of the car.

ELECTRIC RAILWAY. M. T. A. Kubierschky, Berlin, Germany, 598,-731. Filed March 26, 1897. Employs a controller having contacts for closing the motor circuit with the heating circuit open, and subsequently closing the heater circuit after the motors have attained speed.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRIC SWITCH. J. M. Andersen, Boston, Mass., 598,553. Filed Dec. 5, 1896. A cover is provided with a movable portion attached to the movable member of the switch, so that the act of uncovering the uninsulated parts of the switch opens the same.

METHOD OF MANUFACTURING RHEOSTATS, ELECTRIC HEATERS, Etc. H. W. Leonard, New York, 598,568. Filed April 9, 1897. Embodies a number of inseparable resistance steps of practically the same size and design and the ohms of a series of the steps being tapered progressively.

MEANS FOR USE IN OPERATING ELECTRICAL SWITCHES. T. H. Parker, Tettenhall, England, 598,679. Filed Dec. 9, 1897. Consists of a lever and roller escapement adapted to the purpose of operating and locking an electric switch.
AUTOMATIC ELECTRIC SWITCH. F. C. Perkins and J. D. Killip, Buffalo, N. Y., 598,715. Filed Sept. 25, 1897. Details of construction.
SAFETY CUT-OUT FOR ELECTRIC LAMPS. A. N. Lovelace, Knoxville, Tenn., 598,733. Filed June 12, 1897. Designed to be suspended by the hanging cord, together with the lamp.
ELECTRIC TIME SWITCH. G. P. Goodwyn, Arnprior, Canada, 598,864. Filed April 26, 1897. Details of construction.

Telephones:—

COIN CONTROLLED TELEPHONE PAY-STATION. Wm. Gray, Hartford, Conn., 598,610. Filed December 4, 1895. Embodies a sectional toll-box with one part secured in contact with the transmitter base, a signal device rigidly supported on the wall of the toll-box, and a cover containing a money pocket and removably secured to the fixed part of the toll-box.

Classified Digest of U. S. Electrical Patents Issued February 15, 1898.

Alarms and Signals:—

ELECTRICAL ALARM WATER COLUMN. M. L. Bush, Lawrence, Mass., 599,220. Filed June 14, 1897. Comprises a water cylinder containing a float and means at the top and bottom of the cylinder for sounding an alarm with respect to a predetermined height of water to be carried in the steam boiler.

Batteries, Secondary:—

BOX OR CASE FOR SECONDARY BATTERY ELECTRODES. G. W. Harris and R. J. Holland, New York, 598,926. Filed September 3, 1896. Comprises a box of insulating material on the inner side of which are ribs to prevent the plates from buckling.

Conductors, Conduits and Insulators:—

TIP FOR ELECTRIC CONDUCTORS. A. B. Blodgett, Lowell, Mass., 598,972. Filed December 22, 1896. Comprises a conducting core, a non-conducting covering and a conducting needle, having a transverse hole arranged within the covering, and a wire passed through the covering and hole, to retain the needle and wire in place.
UNDERGROUND CONDUIT FOR ELECTRIC WIRES. A. L. Daniels, North East, Pa., 599,292. Filed December 22, 1897. Consists of sections having a metal case, with ends of insulating material of less internal diameter than the case, the ends of adjacent sections being conformed to fit together.

Dynamos and Motors:

DIRECT ACTING OSCILLATING ELECTRIC MOTOR. J. H. Mason, Brooklyn, N. Y., 598,946. Filed March 24, 1897. The oscillating movement of the armature changes the direction of the electric current for alternately swinging the armature a limited distance in both directions.

Electro-Therapeutics:—

ELECTRIC BATTERY FOR MEDICAL PURPOSES. C. W. Moessner, Philadelphia, Pa., 598,948. Filed June 2, 1896. Embodies within a single box the various electrical appliances which are usually required in the practice of medicine and surgery.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. G. R. Lean, Cleveland, Ohio, 598,942. Filed February 20, 1897. Feed mechanism for alternating current arc lamps.
ELECTRIC ARC LAMP. G. R. Lean, Cleveland, Ohio, 598,943. Filed February 20, 1897. Focusing lamp; details of construction.
INCANDESCENT LAMP. J. T. Lister, Cleveland, Ohio, 598,002. Filed October 14, 1896. Means for detachably attaching a cap to the lamp shell and making the necessary electric connections with the lamp socket.
ELECTRIC ARC LAMP. C. N. Black, New Haven, Conn., 599,032. Filed April 20, 1897. Embodies a pivotally-supported armature carrying a plunger and a dash-pot loosely supported from above, in which the plunger works.
ELECTRIC ARC LAMP. C. Tepel, Bennett, Pa., 599,305. Filed March 10, 1897. Feed mechanism.
MAKING FILAMENTS FOR ELECTRIC LIGHTING. D. C. Boss, Boston, Mass., 599,306. Filed August 3, 1891. A process of building up a filament by dipping in the alcoholic solution of iodid of aluminum and then charring the same.

Measurement:—

APPARATUS FOR ELECTRICALLY MEASURING TEMPERATURES. H. L. Callendar, Montreal, Canada, 598,905. Filed July 31, 1896. Comprises a pyrometer employing a galvanometer placed in a battery circuit.
ELECTRIC METER. C. Raab, Kaiserslautern, Germany, 599,046. Filed February 27, 1896. Solenoid meter for alternating currents.
DIRECT CURRENT METER. G. A. Scheeffer, Peoria, Ill., 599,302. Filed May 7, 1896. A direct current meter wherein a registering-train is driven by an armature mounted upon a shaft provided with a damping device.

Miscellaneous:—

FILTERING APPARATUS. C. Palmer and H. G. Brownell, Louisville, Ky., 599,009. Filed January 2, 1897. The water is run through a cell in which iron plates are suspended and through which a current of electricity passes, after which it is filtered through sand.
ENGINE STOP. J. R. and F. P. Reynolds, Hartford, Conn., 598,014. Filed May 29, 1897. Details of construction.
ELECTRIC ELEVATOR. H. Rowntree, Chicago, Ill., 599,015. Filed February 28, 1896. Comprises a main motor, an auxiliary motor, means for controlling the latter, and means actuated by variations in speed of the motors for controlling the main motor.
AUTOMATIC RAILWAY GATE. J. F. Small, Chicago, Ill., 599,019. Filed January 12, 1895. Operated by solenoids.
RAILWAY GATE. J. F. Small, Chicago, Ill., 599,020. Filed March 19, 1895. Similar to above.
TRANSFORMING POTENTIAL ENERGY OF CARBON INTO ELECTRICAL ENERGY. H. Blumenberg, Jr., New York, 599,094. Filed April 7, 1896. The positive element is carbon immersed in molten caustic potash into which steam is injected.
ELECTRIC GAS LIGHTING APPARATUS. W. E. Cram and J. H. L. Clegg, Boston, Mass., 599,121. Filed April 30, 1897. Embodies means to automatically relight the gas if extinguished accidentally.
DEMAGNETIZING DEVICE. H. A. Storrs, Burlington, Vt., 599,304. Filed June 18, 1897. Designed for use in demagnetizing heddles and warp-stop detectors in looms.

Railways and Appliances:—

TROLLEY. C. H. Johnson, Elmhurst, Cal., 598,937. Filed October 24, 1896. Designed for double track roads having a common conductor wire.
TRACK BOND FOR ELECTRIC RAILWAYS. F. T. Mather, Detroit, Mich., 598,947. Filed June 29, 1896. The rail sections are provided with a flanged tread having a continuous groove passing entirely through the flange at the ends of each of the sections, and a continuous electrical conductor lying in the groove and having a loop formed at the junction of each of the rail sections.
INSULATED JOINT FOR RAILROAD RAILS. T. O'Brien, Jr., Philadelphia, Pa., 599,081. Filed June 4, 1897. Comprises a metallic plate having an insulating block seated therein, the plate having a cut-away portion in a wall for the insertion of a suitable implement for removing the block.
ELECTRIC SYSTEM OF PROPULSION. W. M. Brown, Johnstown, Pa., 599,162. Filed May 18, 1897. Consists in the arrangement of the main feeders, sub-feeders, junction boxes, contacts, and safety devices in a conduit system.
ELECTRIC CONTROLLER. F. A. Merrick, Auburndale, Mass., 599,186. Filed May 27, 1897. For railway use. Details of construction.
TROLLEY POLE FOR OVERHEAD ELECTRIC RAILWAYS. J. L. Walker, Louisville, Ky., 599,274. Filed June 18, 1897. Comprises a pole to automatically collapse and fold in the event of the trolley leaving the conductor wire.
TROLLEY ACTUATED SWITCH OPERATING DEVICE FOR ELECTRIC RAILWAYS. L. E. Walkins, Springfield, Mass., 599,307. Filed August 13, 1897. Designed for third-rail systems.

Switches, Cut-Outs, Etc:—

AUTOMATIC CUT-OUT FOR ELECTRICAL CONVERTERS. W. J. Greene, Cedar Rapids, Iowa, 598,922. Filed January 13, 1896. Embodies a controller, a switch closer for the primary circuits, a releaser for the controller-switches, and a connection thereof with the switch closer.
FUSIBLE CUT-OUT. J. Jones, Jr., Brooklyn, N. Y., 598,940. Filed March 12, 1897. The terminals are rigidly connected to the insulating block and the fuse is held in place by springs under pressure of the cover.
CONTROLLER FOR ELECTRIC MOTORS. E. W. G. C. Hoffmann, Charlottenburg, Germany, 598,991. Filed December 29, 1897. Consists in providing in connection with the switching arm an automatically-actuated rheostat adapted normally to cut a predetermined amount of resistance in circuit, but which is maintained in its adjusted position during the time that the switching apparatus is inoperative.

REPORTS OF COMPANIES

New York Edison Co.

The Edison Electric Illuminating Company, of New York, has voted to increase its capital stock by 15 per cent., offering the additional amount to present stockholders at par. Payment is required in three equal installments—on March 10, May 2, and August 2. The new stock does not carry interest or dividends until fully paid. Stockholders may anticipate the full payment receiving 3 per cent. discount until the stock is delivered.

EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK shows a gain in net of $23,345, available for dividend purposes, etc., during January.

METROPOLITAN TRACTION COMPANY OF NEW YORK will, it is said, issue $10,000,000 of additional stock, making $40,000,000 in all, and retiring $6,000,000 of debenture gold certificates. The earnings in February show a gross daily increase of about $3,000.

THE STOCK MARKET

Market Steady In Spite of Spanish Troubles.

The disaster which happened last week, when the U. S. man-of-war "Maine" went to the bottom of Havana harbor, by means unknown, had its natural effect on the stock market; and the end may not be yet. But the nerves of the people have remained unshaken, and there is every indication that if war is precipitated it will not be for lack of self control in America.

During the week, 33,053 shares of Western Union were sold, down to 91, losing only 1½ during all the alarm and excitement. Of General Electric, 21,885 shares were sold, from 37½ down to 34½. In Boston American Bell telephone sold down to 265.

TRADE NOTES & NOVELTIES

General Electric Lamp Inspector's Indicating Wattmeter.

THE successful operation of an incandescent lighting system depends largely upon the use of lamps of proper efficiency. To secure the most satisfactory service and highest economy, the efficiency of the lamps should be as high as the fluctuation of voltage on the circuits will permit. The selection of lamps for a particular installation should, therefore, be made with regard to the regulation obtained with the transformers in use. Efficiency is also the true basis for renewal of lamps, for it is

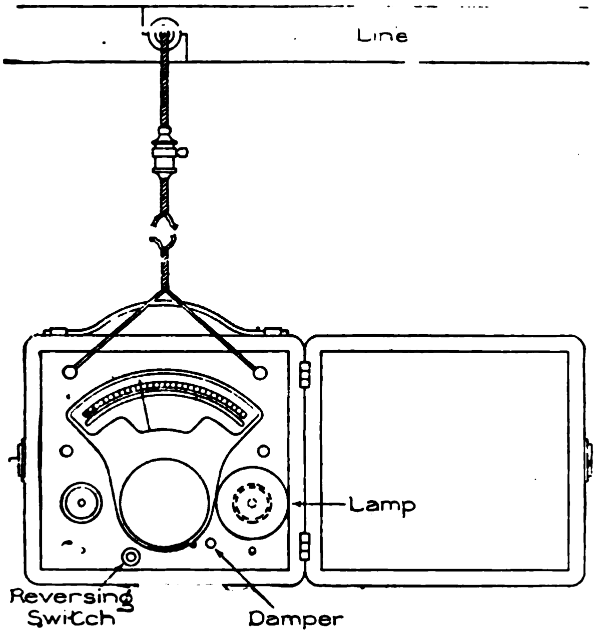


Fig. 1.

manifestly uneconomical to continue a lamp in service when it has so deteriorated that the current it unnecessarily consumes costs more than a new lamp.

A portable instrument to determine accurately and rapidly the watts per candle power required by a lamp, is of great value in selecting new lamps and in testing lamps in service. The General Electric Company has recently designed and introduced

Fig. 2.

the Thomson inclined coil portable indicating wattmeter to meet an increasing demand for instruments of this class.

All of the well known merits of the Thomson inclined coil instruments are embodied in the new wattmeter and the workmanship is of the highest grade. The present design was adopted after numerous experiments to determine the most advantageous arrangement to facilitate rapid testing of lamps without inconvenience to their users. On account of the rapidity with which readings may be made, the indicating wattmeter will also be found invaluable for testing lamps in barrel lots either with or without a photometer. The wattmeter will accurately indicate the energy used by small fan motors and is, therefore, particularly useful in comparing, for a customer's benefit, the relative amount of energy required by a fan motor and an ordinary incandescent lamp. Again by supplying the secondary of a transformer with current, its core loss may be easily determined by the indicating wattmeter.

For rapid connection the wattmeter is supplied with two special plugs, an Edison with T-H adapter, and a Westinghouse, thus providing ready means for connection to the three forms of sockets most generally in use. The lamp to be tested is inserted in one of the receptacles in the base of the instrument, and the proper plug placed in any convenient socket. Lead wires are provided suitably tipped at one end for insertion in the plugs and at the other for connection to the binding posts of the instrument. A small secondary plug arranged to fit the regular plugs and provided with two small binding posts is also supplied with every instrument. With this convenient device the power required by small motors or other apparatus may be conveniently measured.

The capacity of the indicating wattmeter is 150 watts. Lamps of any candle power up to 32 and of any voltage up to 150 may be tested, as may also any device, the consumption of energy in which is not over 150 watts at any voltage not exceeding

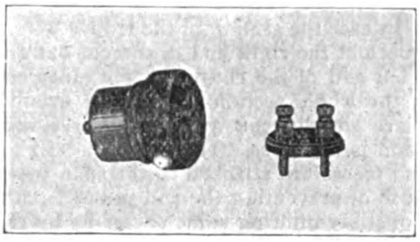


Fig. 3.

150. The fact that the instrument is equally well adapted for use on either direct or alternating currents, necessitates the use of only one instrument in stations using both systems.

On direct current circuits reverse readings should be taken to eliminate the possibility of any slight error which may be introduced in all instruments of this class by the presence of local fields. A special reversing button is provided to reverse the current in the instrument and lamp, without permitting the needle to fall back to zero. The usual convenience of reversing lead terminals is eliminated by the reversing button. When reversed readings are taken the mean of the two is, of course, taken as the final reading.

Another advantageous feature of the instrument is the damping device. A button is provided which releases the needle or pointer from the damping brake only when depressed. When the button is released the needle is held at the point of the last indication; therefore, if the current is turned off and then on again, or reversed, the necessity of waiting for the pointer to swing from zero to a state of rest is avoided and very rapid readings may be taken. The terminals, reversing and damping buttons are mounted on a vulcanite baseboard above which the graduated dial slightly projects.

The instrument is mounted in a finely polished carrying case, with snap lock. It is light and compact, the external dimensions being 7⅜ x 7 x 4½ inches. All parts are finished in polished nickel plate.

Puritan Electric Co.

Deputy Sheriff Gilligan last Friday took charge of the office at No. 11 Broadway, N. Y., of the Puritan Electric Company on executions aggregating $3,663, in favor of the Manhattan General Construction Company, on notes. The Puritan Electric Company was incorporated in October, 1896, with a capital stock of $100,000, and manufactured enclosed arc lamps. Stuart W. Wise was president and the concern was regarded by the trade as an adjunct of the Manhattan General Construction Company. The company was understood to be doing a large and progressive business.

The Live Wire Cut-Out.

THIS invention, which has been placed upon the market by The Live Wire Cut-Out Company, 35 Warren street, New York, consists in the combination with an overhead conductor forming part of a ground circuit and made of independent sections of a safety device or cut-out interposed between adjacent sections, whereby the current is cut off from the ground through a broken section.

The object of this device is to perform automatically and instantaneously the purposes of the invention, thereby rendering the broken section dead, removing the liability of accidents, and preventing the broken wire from having any live ends to come in contact with a person or animal, and, by thus completing a short circuit to the ground, to produce serious results. The device is composed of three pieces, and, upon a trolley wire, displaces the clip at each span. The end pieces, when properly suspended, engage the surface and bolts of the center piece, so as to form a perfect connection, and are held in place by the strain of the wire. In case the section of the trolley wire, held in place by the end piece at the right end of the cut-out and by the end piece at the left end of the cut-out at the other end of the section, breaks, the whole section falls to the ground uncharged; this takes place simultaneously with the breaking of the wire and the section is harmless. The insulated wires, by means of which the end pieces are attached to the span wires, are merely for the purpose of preventing the end pieces from falling to the ground and possibly injuring some passer-by by the blow.

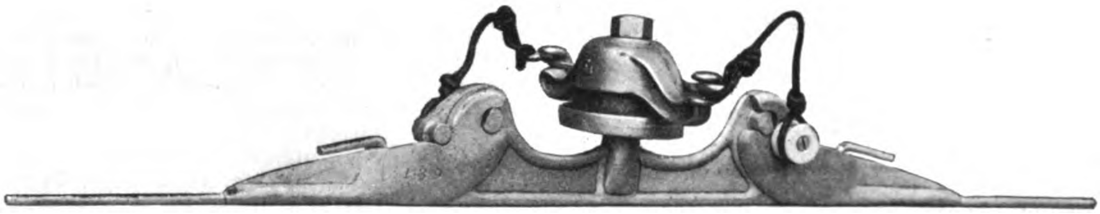


FIG. 1.—THE LIVE WIRE CUT-OUT IN ITS NORMAL POSITION ON THE LINE.

It renders the use of a wire (a smaller wire if desired) practicable until the wire is worn out. It offers special facilities for repairs without interference with the service of any section of the line, or with the machinery at the power house, a constant supply of electricity being maintained to all other points of the line through the various feed wires. On a single track road, the trolley car can by its own ~~momentum run by~~ the broken span, or, on a double track road, transfer, if preferred, the ~~trolley to~~ the other wire. It is useful in case of fire, for the accommodation of moving buildings, and for taking up slack. It is applicable to any wire.

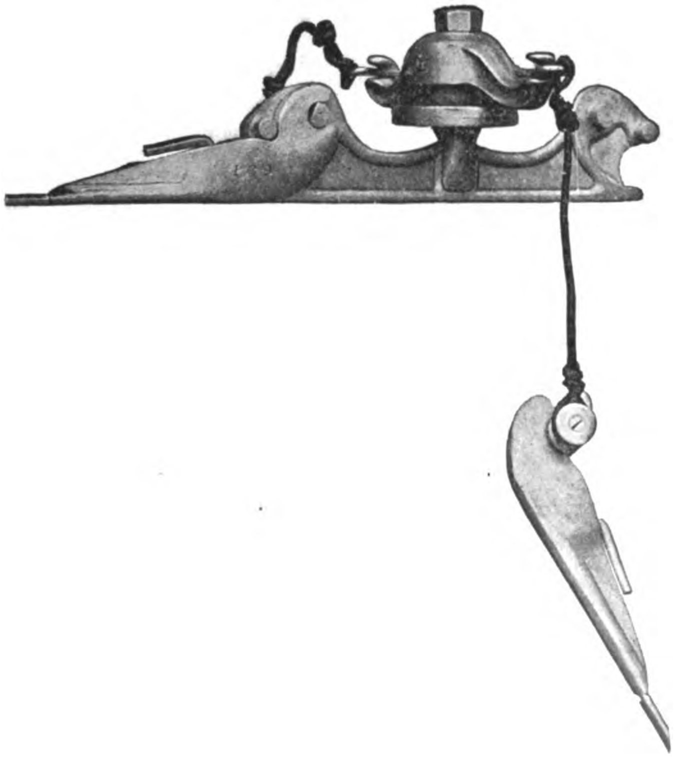


FIG. 2.—THE LIVE WIRE CUT-OUT IN ACTION.

The cut-outs have been in operation on the entire line of the Tremont and Suffolk Mills, Lowell, Mass., and also the line of the Washington Mills, of Lawrence. Thirty cut-outs have been used on the Albany Traction Company's road in Albany, and they have been endorsed by the electrical engineer of the Nassau Railroad Company, of Brooklyn.

A Decision As To Cement Lined Conduits.

The National Conduit and Cable Company inform us that Judge Townsend has sustained his original decree perpetually enjoining the Connecticut Pipe Manufacturing Company from making or selling cement lined conduit as covered by the Phipps patent, No. 395,584, owned by the National Company, except so far as the same relates to water pipes. The injunction restrains also all officers and agents of the defendant company, and the decree calls for an accounting of damages and profits.

CATALOGUES.

C & C Electric Co's. Iron-clad Dynamos and Motors.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, have just issued a bulletin illustrating their ironclad dynamos and motors. These machines, which were placed upon the market during the summer of 1897, and have been illustrated in our columns, have met with pronounced favor and there is practically no limit to the uses to which they may advantageously be put. The sizes range from 5 to 50 h. p. or 4½ to 45 k. w. and are designed to run at either slow or medium speeds. They are wound for 125, 250 and 500 volt circuits. The motors are shunt-wound and the dynamos compound-wound. The closed-type machine is constructed so that it requires but the minimum of attention. Ready access to the brushes and commutator may be had, if necessary, by the removal of the solid iron covers fitted over the hand-holes in the end plates. The only difference in construction between the closed and open type machines lies in these hand-hole covers. The motors are unsurpassed for driving all classes of large machine tools, rolls, shears, hoists, cranes, elevators, draw-bridges, pumps, and similar machinery. They are also unsurpassed for driving lines of shafting through means of gears or direct coupling. The cylindrical casing forms the magnetic frame and is of soft cast steel of high permeability. The bearings are self-oiling and self-aligning and the field coils are wound with soft copper of 98 per cent. conductivity. The armature is of the slotted drum type with removable coil winding, which are uniform and interchangeable. The machines are equipped with the company's well known "reaction type" carbon brush holders, which permit of the reversal of the direction of rotation of the armature without injury to the brushes or commutator, and without any sparking. The efficiency of the machines is unusually high and the temperature of the windings never rises above 45 to 50° C. They are adapted for use in direct connection with vertical engines where a lighting unit is required which shall be thoroughly stable, require little attention and occupy but a small floor space.

The field regulator is of an entirely non-combustible type and the C & C automatic starting box fulfils all the requirements of the most rigid underwriters' specifications.

Kieley & Mueller Steam Specialties.

The new catalogue of Kieley & Mueller, manufacturers of engineering specialties, 7 to 17 West Thirteenth street, New York, contains numerous illustrations of the many high-grade steam appliances manufactured by the company, and the various uses to which they can be put. The following apparatus are described and illustrated in section: Low pressure reducing valves, vacuum pressure reducing valves, high pressure reducing valves, marine high pressure reducing valves, back pressure valves, standard steam traps, extra heavy steam traps, strainer connections, special low pressure balanced steam traps, champion return steam trap and boiler feeder, positive acting pump governor, water pressure regulator, tank pump controller, combined pressure regulator and water feeder, improved climax damper regulator, Climax damper regulator, multi-tubular oil and grease extractor, improved steam separator, standard tubular water arch for steam boilers, Empire drain trap. The catalogue contains many diagrams illustrating the use of the apparatus.

The Central Telephone and Electric Co.

The Central Telephone and Electric Company, of St. Louis, Mo., have issued a new illustrated circular, setting forth the advantages of their high-grade telephones, telephone parts and exchange switchboards. Their "Central" transmitter is claimed never to get out of adjustment, as neither springs nor carbon dust are used in its construction. The company can supply complete sets of apparatus for exchanges, including the line equipment, such as poles, wires, cross-arms and insulators. Their "Central" exchange and toll-line switchboards embody many novel and useful features.

Ward Leonard Electric Co. Porcelain Lined Outlet Boxes.

THE Ward Leonard Electric Company, Bronxville, N. Y., have just issued their tenth catalogue, this one illustrating their cast iron outlet boxes, with porcelain lining. It is claimed that by means of the company's special enamel the contents of the outlet boxes can be permanently insulated from the cast iron of the box, so as to withstand 2,000 volts alternating. The insulation is absolutely moisture proof and does not depreciate in any way with time. It will withstand an exceedingly high temperature if necessary; no vibration can affect it, and no chemicals have any influence upon the insulation of the enamel. The Ward Leonard Electric Company is the only concern in the world, so far as we know, who use a special porcelain of this kind of their own manufacture, and who are prepared to undertake special applications of enamel insulation. The merits of these outlet boxes are rapidly being recognized by electrical engineers and contractors, and over 81,000 of them were installed in New York City alone during 1897; 14,000 of which were used in the Astoria Hotel, 5,000 in the Columbia College buildings, 4,000 each in the New York and the Metropolitan Life Insurance Companies' buildings and 3,000 in the Manhattan Hotel.

MICHIGAN PIPE COMPANY'S CREOSOTED WOOD CONDUITS.—In a recent catalogue of the Michigan Pipe Company, Bay City, Mich., the advantages in the use of creosoted wood conduits, treated by the Bethel process, are stated as follows: "It does not destroy insulation. It has but one joint in eight. The holes are straight and smooth. Cables are not scratched in pulling them through. When struck with picks, only a hole the size of the pick is made. Several joints cannot be broken by a blow, as is the case with some other materials. It does not require a concrete foundation. It does not affect the cables. It will last forever. Wires are reached between manholes more easily than in any other conduit. Construction takes less time. It can be laid around unmovable obstacles encountered in trenches, at the same cost per lineal foot as straight conduits. The creosote will prevent vegetable growth from reaching the conduits." The pamphlet gives valuable information about the history of creosoting, the nature of the substance and process used and the durability of wood thus treated. The company also manufacture the Wyckoff water pipes, which are not subject to electrolysis, as has been shown by tests and years of experience.

The Cambria Steel Rails.

WE have just received Vol. II. of the catalogue of the Cambria Iron Company, Philadelphia, Pa. This beautifully illustrated, cloth covered book measures 11½ x 12 inches and contains over forty full-page illustrations of steel rails and tie plates manufactured by the company. Each plate embodies an elegantly executed working drawing, with all necessary dimensions and weight per yard and mile. The book also contains useful information about materials for track construction and is one of the most complete and carefully executed catalogues which has come to our notice. It is a creditable production and speaks well for the meritorious goods manufactured by the company. The book should find a place in every well-selected engineering library and in the office of railway superintendents and engineers.

NEW ENGLAND NOTES

THE LIVING AGE FOR 1898. In another column will be found a prospectus of this standard periodical. Founded by Eliakim Littell in 1844, it has steadily maintained the reputation gained with its earliest issues of being the most complete representative of foreign thought as expressed by its greatest exponents. It is to-day a faithful reflection of almost all that is substantial and truly valuable in the passing literature of the world, embracing as it now does in its Monthly Supplement, American as well as foreign literature. While its pages show the same wise and judicious discrimination which has ever characterized its editorial management, the scope of the magazine has been widened, its size increased and its price reduced, so that increasing years seem only to add to its vigor and value. To those whose means are limited it must meet with especial favor, for it offers them what could not otherwise be obtained except by a large outlay. Intelligent readers who want to save time and money will find it invaluable. The Living Age is published weekly, and the price is now but $6.00 a year. To all new subscribers for 1898 are offered free the eight numbers of 1897, containing the opening chapters of the new serial, "With All Her Heart," described in the prospectus.

NEW YORK NOTES.

MR. FRANK B. WIDMAYER, No. 482 Western Boulevard, New York City, formerly with the Ball Electric Light Company and late of the firm of Burkart & Widmayer, has recently bought Mr. Burkart's interest and will conduct the business of electrical engineer and contractor at the above address and will give particular attention to electric gas lighting, burglar alarm and repairs on medical batteries, electric motors, etc. He will carry a full line of electrical goods and novelties, and will act as the uptown agent for the Acme electric adjustable lamp and supplies and the Iver Johnston line of '98 bicycles. He invites his many customers and friends to call in and examine his line of electrical and bicycle novelties.

MONTAUK CABLE.—A large number of the prominent jobbing houses throughout the country are interesting themselves in the products of the Montauk Multiphase Cable Company, with the idea of introducing their new and ingenious thermostatic cable to the electrical trade.

M. C. HENRY & CO., of New York City, are enlarging their plant and making some extensive improvements. Their new steel stone shed, which is about 50 feet wide, is to be extended about 70 feet in length. The metal work, which consists of the steel framework of the building, the covering upon the roof and sides, and the metal runway for a traveling crane, is being furnished and erected by the Berlin Iron Bridge Co., of East Berlin, Conn.

HARRISON, N. J.—Among the extensive improvements now being made by the Benjamin Atha & Illingworth Company, at

Harrison, N. J., is a new steel edifice known as the Tower Building. This building is 30 feet square and about 40 feet high. Thirty-five feet above the ground is a circular trolley track carried by the roof trusses. The framework of the building is of steel throughout, and the siding and roofing of corrugated iron. The complete contract for furnishing and erecting this building has been given to the Berlin Iron Bridge Company, of East Berlin, Conn.

THE VACUUM GAS ENGINE, POWER AND MACHINE COMPANY, of Mount Holly, N. J., has filed articles of incorporation. The object of the company is to manufacture gas engines, a recent patent of Thomas Small, of Camden; also dynamos, electrical supplies, water wheels and other kinds of machinery. The capital stock of the company is $100,000. The incorporators are S. Prentice Comegys, Smithville; Chas. A. Wilson, Philadelphia; John B. Davis, Bradford W. Storey, John M. Huff, Mark R. Sooy, Mount Holly; Francis Fennimore, St. Davids, Pa., and Thomas Small, Camden.

SOUTHERN NOTES

B. & O. CHANGES.—On March 1, Edward S. King, now commercial freight agent of the Baltimore and Ohio Railroad Company at Baltimore, will be transferred to Philadelphia with the same title and duties. His successor in Baltimore will be H. W. Atkinson, now chief clerk to General Freight Agent Galleher. J. R. Bell, of the general freight office in Baltimore, will succeed Mr. Atkinson as chief clerk in the freight department.

WESTERN NOTES

MR. CYRUS ROBINSON, who recently resigned from the Ridgway Dynamo and Engine Company, has associated himself with the Hammond Manufacturing Company, of Portland, Ore., who manufacture stamp mills, ore crushers, and who are contractors for complete mining plants. Mr. Robinson, who is an expert civil and mining engineer as well as an electrical engineer, intends to push the electric equipment of mines, long distance transmission work, etc., and believes that there is a large field for development in the Northwest. Mr. Robinson is well known in the East and Middle States, and his many friends will wish him well in his new sphere of enterprise.

THE WESTERN ELECTRIC COMPANY manufactures a very superior disc Leclanche porous cup cell, especially adapted for bell and annunciator work. They make the batteries complete or furnish the porous cup without zinc or glass jar.

SWARTS METAL REFINING COMPANY, 20 North Desplaines street, Chicago, have requested us to mention the fact that they are not in any way connected with the Swarts Iron and Metal Company. The two concerns are quite distinct, on different lines, and have at no time been connected in any way. The Swarts Refining Company are in business at the old stand and ready to fill any orders that may be entrusted to them.

MR. FRANCIS M. RAYMOND, general sales agent of the Chas. E. Gregory Company, Chicago, reports that among their recent orders for apparatus was a shipment of generators and motors to a large sugar refinery in the Hawaiian Islands, and a lighting and power plant for the Alaskan gold fields.

THE JONES BROS. ELEC. CO., of Cincinnati, has increased its capital stock from $200,000 to $220,000.

THE CENTRAL ELECTRIC CO. has taken the Western agency for the Erickson outlet insulator, brought out to meet the demands of engineers for a thorough and perfect protection at the ends of iron armored conduit outlets. It very effectually and thoroughly prevents possible grounding of the wires on the iron conduits and has met with a very ready sale.

FISHER ELECTRIC CARRIAGES.—That the electric motor vehicle has come to stay is evident from the fact that Messrs. Sipe & Sigler, manufacturers of the Willard storage battery, have just closed a contract extending over a period of three years with the Fisher Equipment Company, of Chicago, for Willard storage cells amounting to $238,000 for motor vehicle propulsion.

CINCINNATI, O.—Bids for the construction of the new Edison Electric Light Building at Plum and Charles streets have been opened. The contract was awarded to James Finnegan and associates at their bid of $117,000. The building will be composed of iron and brick, two stories high, covering an area of 107 x 250 feet. A Chicago and St. Louis firm each bid, but their lowest proposition was $140,000. Work began Monday and will be completed in 120 days.

CONTENTS

Department News Items will be found in advertising pages.

The Electrical Engineer.

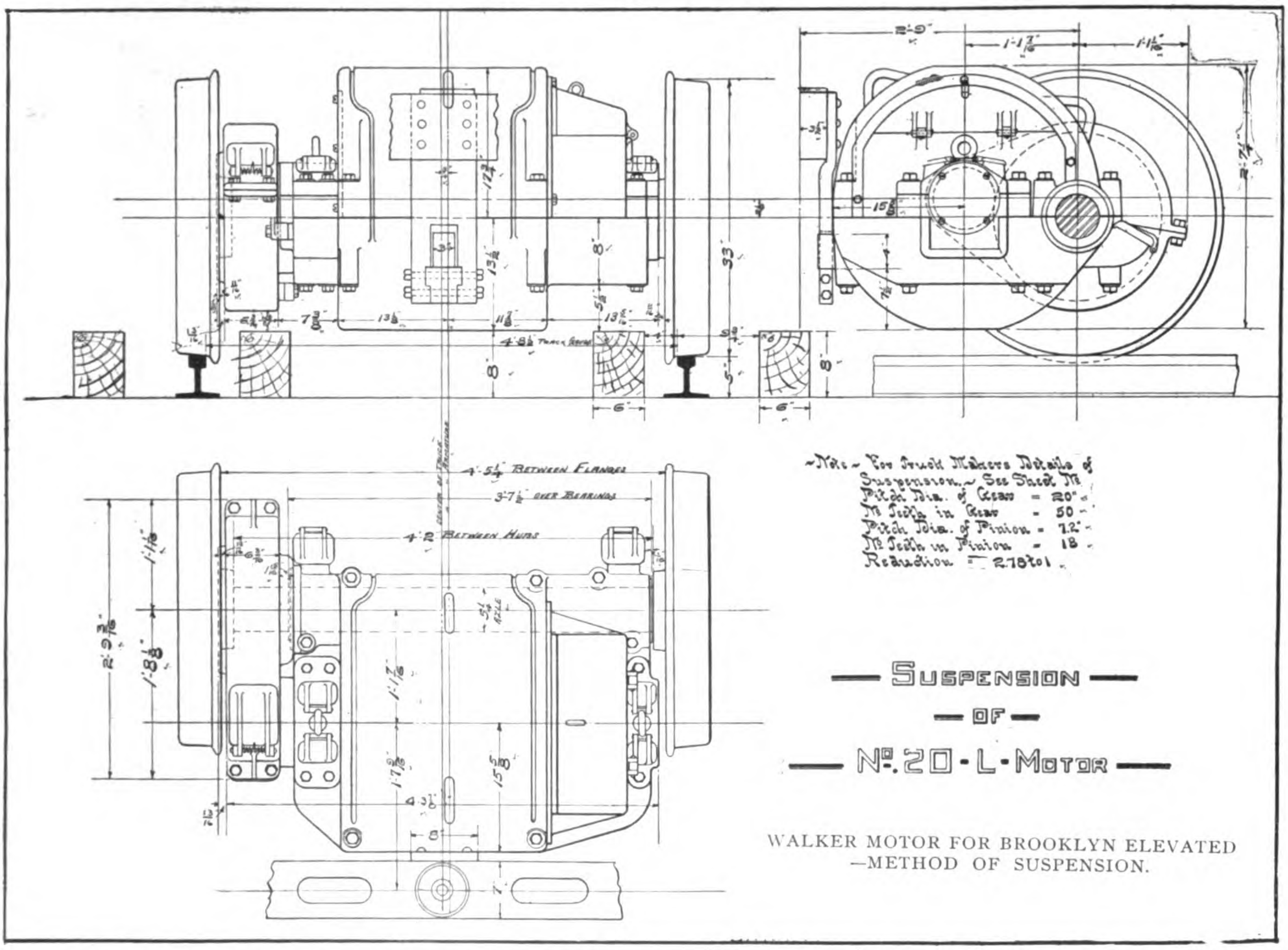
Vol. XXV. MARCH 3, 1898. No. 513.

ELECTRIC TRANSPORTATION

Electrical Equipment of the Brooklyn Elevated Railroad.

ONE of the most important announcements ever made in regard to electric traction work was given publicity last week. It is stated that the Brooklyn Elevated Railroads have closed contracts with the Walker Co., of Cleveland; the Sprague Electric Co., of New York City, and the Pullman Car Co., of Chicago, for a complete electrical equipment of their system, to be undertaken without delay; and we now learn with great pleasure that the work is being proceeded with promptly. It is in many ways a memorable event, and there is a peculiar fitness in the electrical conquest of the elevated roads of Greater New York in the first year of its corporate existence. While but in Brooklyn the great bulk of travel is concentrated in about four hours, two in the morning and, refluently, two at night. During the rest of the day single cars will normally answer all purposes, or, at most, trains of two. This led to the adoption of the Sprague ingenious "multiple unit" system, which gives a whole train the characteristics of any separate car, and allows the train to be handled from either end, and the cars to be hitched up in any combination regardless of end relation.

Prof. Sidney H. Short, whose apparatus is being furnished by the Walker Co., of which he is the chief engineer, has been peculiarly fortunate in being able to supplement his long experience as an electric railway inventor by his tests on the West Side Elevated in Chicago. He brings to the Brooklyn work the matured results of all the data secured in Chicago. It is now at least a year since he built his big motors for that work, sent them out to Chicago, and began a series of special studies and experiments the object of which was to detect any latent weaknesses and correct whatever deficiencies might be developed. Tremendous currents were thrown on and off, the tests of acceleration were pushed to the utmost degree, and the ability of electricity to take care of heavy travel was tried in every



WALKER MOTOR FOR BROOKLYN ELEVATED —METHOD OF SUSPENSION.

the honor of receiving the pioneer equipment falls to the Borough of Brooklyn, as did that of being prompt to install the trolley, there can be no doubt that the elevated system on Manhattan Island must be profoundly affected and must perforce soon follow suit. When we remember how long and fiercely the prize of equipping the elevated roads has been struggled for, the companies now receiving the contract are certainly to be congratulated on their success, coming as it does at so striking a stage in the expansion of the enlarged metropolis.

It is perhaps not generally recognized that there are profound differences between the two elevated systems of Brooklyn and Manhattan, in respect to the service. There is a more or less steady stream of travel on the New York roads all day long, possible manner. Fortified by highly successful results, Prof. Short was able to submit a well rounded scheme to the authorities of the Brooklyn Elevated, at the "psychological moment" when something had to be done; and after a thorough investigation by their engineers his plans have now been adopted. Prof. Short also indorsed warmly the unit control system as meeting the peculiar conditions which demand ten car trains morning and night for the 60 per cent. of patronage then to be handled, and which, as already stated, include the necessity of working on a narrow basis during the middle part of the day with a minimum of rolling stock in service.

Through the courtesy of the Walker Co. we are able to illustrate herewith the Short motors for the Brooklyn "L" roads,

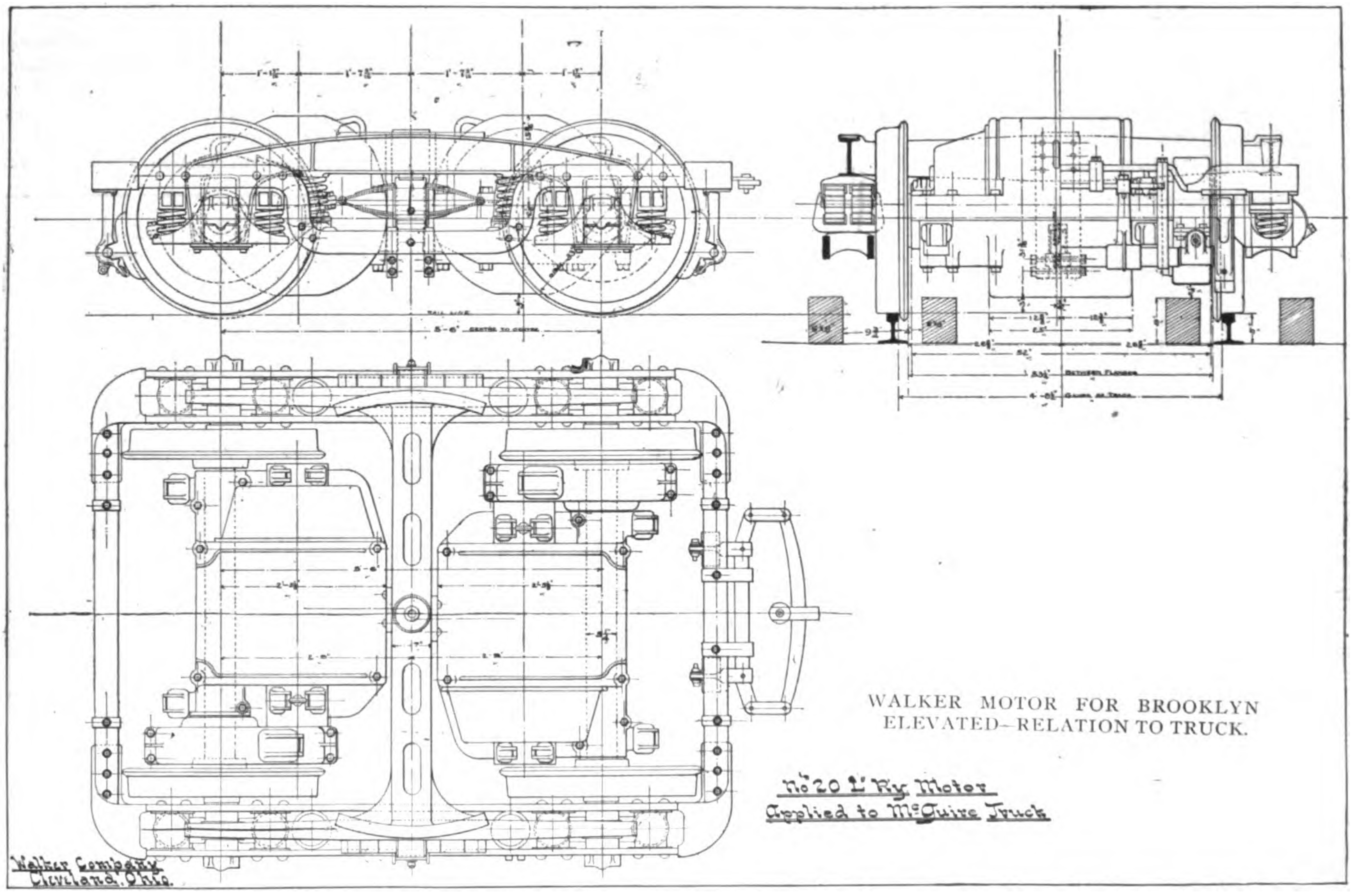
showing the method of suspension; also the relations between motor and truck. The company have received orders for fifty motors, making twenty-five car equipments, two motors to each car; and is to have the work ready for operation in ninety days, further contracts coming for 100 more motors; making 75 car equipments in all. The trucks are of McGuire make. Each Short motor is of 80 h. p., all steel, 4-pole, the full armature speed being 450 revolutions per minute. The motors are so built that the steel tires can wear down 1½ inches and still leave safe clearance. They embody all the improvements and perfections suggested by Prof. Short's work in Chicago, and are confidently relied on to make a fine showing and to settle the whole question for New York. The bearings are very massive, being 10 inches long and 4 inches in diameter. The gears are 5-inch face and 2½-inch pitch. Every bearing is hard bronze. The axles are 5¼ inches.

As will be noted, the magnet frames are circular, being cast in a perfect ring, like that of a direct-connected generator; in fact, they are quite distinctly of a generator type in massiveness and solidity. Bolted on the inside of the frame are the four laminated steel pole pieces with pole shoes on them, as in a generator. The upper half of the ring and the armature lift out from above. The lower half is suspended, being attached to a girder which goes across from one side to the other, as shown. On each side or end of the shaft is an oiling box bolted down, with openings on each side through which waste is pushed. The box is filled with oil which is taken up by the waste, and this in turn lies against the armature shaft, and wipes and oils it all the time. The brasses for the armature are in two parts, one above and one below, adjustable to take up wear, like car brasses. There is a lid over the commutator to prevent dust from getting in, etc. Not only are the armature bearings so protected and housed as to use the same oil over and over again from the end pockets, and to avoid drip, but the axle as it passes through the frame of the machine takes up oil from the wells and returns it in the same way. The gear housing is of heavy steel, bolted tightly together, and provision is made all around against oil spilling. The openings toward the wheels are also protected by a felt washer ring fitting close against the flange of the gear case. In fact, although the whole thing is run in oil and profusely lubricated, the chance for escape of oil is reduced to a minimum. An equally important matter is the care taken to prevent the oil from getting into the motor itself.

All the windings of the motors, both field magnets and armature, are bar copper. There is no wire in the machine at all. The entire insulation on this copper bar conductor is mica and asbestos. No cotton or cloth is used at all. In other words, the insulation is absolutely fireproof; it could be put in a fire and would sustain no hurt. The Walker Co. have made a very intimate study of the use of mica, and use it generously to the best advantage in these machines, and this in spite of the fact attested in the Chicago work, that they run remarkably cool. Still, it is a wise thing to be on the safe side, in view of the heavy work that may fall to the lot of such machinery. It is obvious that motors propelling heavily loaded cars, and giving acceleration up to two miles per second, every minute or so, are under a heavy strain.

In the armature, which is built up like that of a generator, the "windings" of bar copper are sunk into very deep slots. A strip of thick asbestos is put over the windings, and the binding wires are also sunk in to such an extent that the teeth of the radial slots of the laminated core project at least three-eighths of an inch beyond the bar copper windings and their insulation. Both the armature and the fields secure very thorough ventilation from a free circulation of air.

The cars equipped with these motors are guaranteed to have a speed of about sixteen miles an hour, schedule time, with station stops; or if four of the motors are grouped in one car for special purposes, eighteen miles an hour, including stops. It is noteworthy that at one time the Brooklyn Elevated officials and engineers inclined to the use of electric locomotives, but they were soon convinced of the superiority of the methods now adopted, the chief reasons being the infinitely greater flexibility of the service and the securing of greater power for a train without added weight on the structure of the road. The gain to the Brooklyn Elevated in capacity will reach, it is said, 50 per cent., while the public which has been lured away by the swifter and more frequent cars of the surface roads, will be attracted back again by the clean, cheerful, handsome and swift trains on the elevated. For the present, current at 500 volts will be taken, however, from existing street railway power plants, until the increase in the service necessitates other sources of supply. The cars are, it is understood, to be run over the bridge to New York, and will thus offer further facilities to Brooklynites hav-



WALKER MOTOR FOR BROOKLYN ELEVATED—RELATION TO TRUCK.

ing business west of the bridge. The first part of the equipment will probably go into operation about June 1.

Austrian Narrow Gauge Electric Locomotive.

THE Vereinigte Elecktricitäts-Actien Gesellschaft, of Vienna, formerly B. Egger & Co., have recently built an electric locomotive for the brewery of Dr. Schaup, of Zipf, Upper Austria (between Wels and Salzburg). It is intended for hauling two or three freight trailers, as well as conveying passengers, for whom seating capacity is provided in the cab of the locomotive itself, back and forth from the brewery to the railroad station.

The tracks are narrow gauge, namely, 2¼ feet. The locomotive in going from the station to the brewery has to ascend a considerable grade, but can make the return trip without using any current, electrical energy only being required for start-

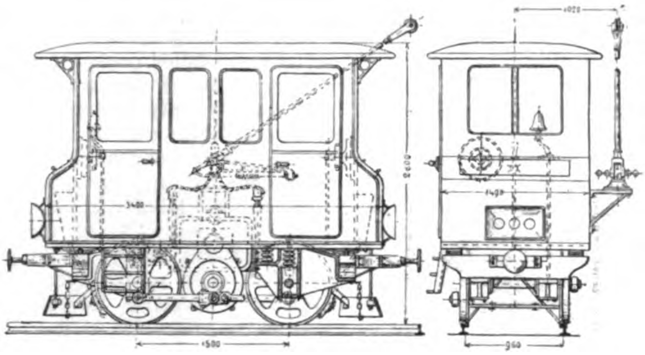


FIG. 1.—NARROW GAUGE LOCOMOTIVE.

ing. The wheel-base measures a trifle less than five feet, so small, that the sharpest curves can be rounded without the least danger. The speed of the locomotive is 6¼ miles per hour. Its driving wheels are 27½ inches in diameter and the load is about 13 tons. The 15 h. p. series motor makes 290 revolutions per minute when fully loaded, and the e. m. f. of the circuit is 500 volts. The weight of the locomotive, including the motor, is about nine tons. With its weight and drawbar pull the locomotive easily ascends the maximum grade of 24 per cent.

The Truck.—In the construction of the truck the motor itself has been made use of. On the lower portion of the motor, on both sides, two strong U-shaped cast steel beams are attached, so that four arms extend from the motor. These arms are so shaped as to form supports for the axle bearings, on which they rest by means of strong spiral springs, as shown in Fig. 1. Each set of arms carries a crossbeam on which the bumper and chain are mounted. The entire base and motor are thus protected by springs from shocks. This construction was the device used by Mr. Eikemeyer.

The transmission of motion from the motor to the driving wheels is accomplished as follows: On each end of the shaft of the motor is a bronze gear wheel. These are geared to a toothed crank disc whose common axis is located beneath the motor. From these crank discs the rotary motion is transmitted to the wheels by means of connecting links. This arrangement enables both axles to be driven by one motor, which is a desirable feature in ascending heavy grades. The crank pins on these two crank discs are placed at an angle of 90 degrees with respect to each other in order to avoid any uneven mass acceleration, which results from the arrangement used. The transmission of motion is uniform and the arrangement very satisfactory in this respect.

The Motor.—The motor, as already stated, is of the two-pole series type. It is entirely enclosed, and thus protected against dust and moisture. The magnetic frame consists of two parts; the upper portion is bolted to the lower one and can be raised through the floor of the car, and the lower portion, as already described, forms a part of the truck. The commutator may be reached through small hinged doors in the upper part of the frame. A slotted armature is used, wound with formed coils insulated with mica.

The Cab.—The upper portion or cab is constructed of wood, is strengthened by means of flat and angle irons and covered on the outside with tin. The roof is 9¼ feet above the tracks and the width is nearly six feet. At both ends the locomotive curves out and in this space the sand box and rheostats are located. The interior of the locomotive is divided laterally into two parts by two rows of seats placed back to back. These seats may be so turned as to face towards the front of the cab. This makes it possible to open the trap in the floor in order to reach the motor.

The Brakes.—The braking mechanism of the locomotive is represented by an ordinary chain brake, and the operation can be performed at each end. All four wheels are braked. The braking lever has a Riedel signal bell attached to it, which can be sounded without loosening the hold on the lever. The sand boxes are located, as already referred to, in the outward extension at the two ends of the locomotive. From here the tubes are led very close to the points where the wheels come in contact with the rails. Special attention had to be paid to the operation and construction of these sand boxes on account of the steep grades. Failure of operation, especially in winter, might cause serious accidents.

Electrical Equipment.—This consists of a brake handle, sand box lever and controller at each end. The controller is screwed against the wall and is used for starting the motor and regulating its speed; this is done by cutting resistance in and out of the circuit. By means of the controller the armature can be short-circuited and act as an electrical brake. Besides the apparatus mentioned, there are the necessary switches and safety devices for the lighting equipment.

The latter consists of two incandescent lamps attached to the ceiling and two signal lanterns, one at each end, and each containing three incandescent lamps. The method employed for lighting the locomotive is as follows: Going in one direction, the signal lantern at that end and the two interior lights, and going in the other direction the other signal and the two interior lamps are used. If the locomotive, however, has a trailer attached, then the signal lantern and only one interior lamp, besides one lamp in the trailer, are lighted. The combinations are controlled by two switches.

Current Conductors.—The current is supplied by an overhead trolley. The trolley pole is not, as is commonly done, attached to the roof of the locomotive, but to a bracket at the side. This construction was adopted, because the locomotive, which was in itself 9¼ feet high, had to pass through tunnels 9¾ feet in height, which made the use of the trolley pole on the top of the car an impossibility. The trolley wires were already in place

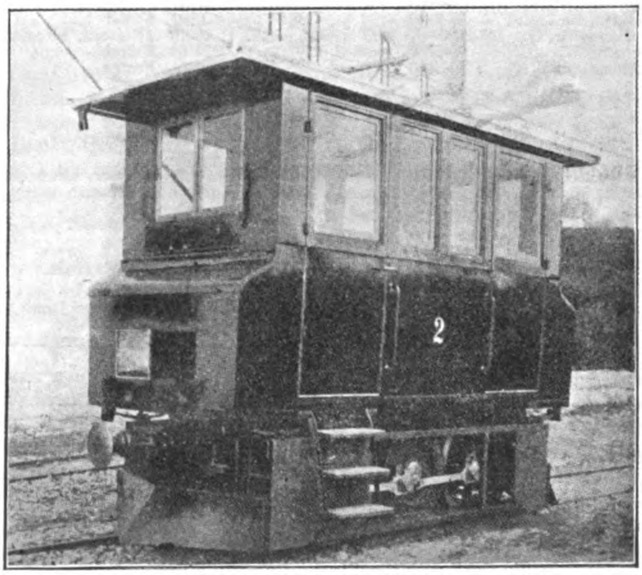


FIG. 2.—NARROW GAUGE LOCOMOTIVE.

when the locomotive was ordered and delivered. Below the trolley stand lightning arresters and main fuses are located. These are well protected against the weather and the fuse is enclosed in an earthenware box. At each end of the locomotive there is an attachment for clearing the tracks. The crank discs and gears are protected by cast iron casings, which are so shaped as to allow free movement of the crank pins, which take up sufficient oil on their under side to have the gears run continuously in oil. These casings are so constructed as to prevent the entrance of dust.

The entire truck is surrounded with a tin casing, which is

constructed in such a way as to allow access to all parts through small apertures. All these precautions enable continuous runs to be made with perfect safety and reduces the necessary attention to a minimum. We also wish to call attention to the remarkably small current consumption which is with a load of 13 tons on a 24 per cent. grade and a speed of 3¾ miles per hour, 24 amperes at 500 volts. A perspective view of the locomotive is shown in Fig. 2. The above illustrations and data were taken from the "Zeitschrift für Elektrotechnik," Vienna.

Municipal Electric Lighting.[1]—II.

BY PROF. JOHN R. COMMONS.

It will be seen that the labor cost in the New York City private plants is $3.88 per arc less than in Detroit and $16.71 less than in Chicago. This difference is accounted for in two ways: first, by the much larger output per station in New York City; second, the higher wages, shorter hours and, consequently, larger staff of employees in the public plants. In the larger cities, on the other hand, the larger output and larger units in boilers, engines and dynamos would tend to reduce the labor cost per unit of product. The case of Allegheny, with its extremely low labor cost notwithstanding short hours is noteworthy.

It should be said as an offset to the low wages and long hours in smaller places, that the work is much easier than in large plants. When one fireman and one engineer run a small plant of 100 arcs in conjunction with water works, probably less than one-half their time is employed in actual work. The cost of living, too, is much less than in cities. Consequently the urgency for both high wages and short hours is relatively less.

PUBLIC PLANTS WITH COMMERCIAL LIGHTING.

3. Labor Employed, 60-72 Hours per Week.

	Arcs.	Per Year.	Per Lamp Hour.	Authorities.
Hannibal, Mo....	350-2000	$14.89	$0.0068	Foster.
Luverne, Minn...	124-2000	8.71	.0048	Foster.
Farmville, Va....	68-2000	30.02	.0139	Foster.
Madison, Ga......	73-2000	28.51	.0132	Foster.
St. Clairsville, O..	105-2000—80-2000	9.25—15.97	.0070	aParsons. bFoster.
Chehalis, Wash...	90-2000	45.61	.0118	Foster.
Westfield, N. Y...	110-2000	21.08	.0124	Foster.

4. Labor Employed, 48 Hours per Week—Street Plants Alone.

	Arcs.	Per Year.	Per Lamp Hour.	Authorities.
Chicago, Ill.......	1,110-2000	52.21—52.20	.0131	aFoster. bParsons.
Detroit, Mich....	1,700-2000	38.38	.0101	Computed, 1897.
Allegheny, Pa....	620-2000—1,235-2000	27.00—23.46	.0058	Parsons, Computed, 1897.

5. Private Plants.

		Per Year.		Authorities.
N.Y. City average	....	34.50	......	Parsons.
N.Y. State average	....	19.50	......	Computed from Census, 1890.

WATER WORKS AND ELECTRIC PLANTS COMBINED.

A very important advantage in a small town is the ability often to combine the electric lighting plant with the water works. That most industrious opponent of municipal ownership, Mr. M. J. Francisco, of Rutland, Vt., in his astounding pamphlet, "Municipal Ownership, Its Fallacy,"[2] is constantly insisting on the duplicity of municipal officials who charge the salaries of firemen, engineers and superintendents of electric works to the water department. In all such cases he forthwith corrects the dishonest officials by charging all the wages and salaries in the water works to the electric light department. The relative honesty of the two methods may be judged from the following typical cases:

The village of Batavia, N. Y., owning and operating its water works system, decided, in 1893, to add an electric lighting outfit to the plant. An addition was made to the water works building for the electrical machinery, and a new boiler was erected. Two engineers, at $65.75 per month each, had been all the force needed for the water works. For electric lighting there were added one electrician at $65, one trimmer at $45, and one fireman at $45, and the engineers' salaries were increased $5 each per month; making the total additions $165 per month, $1,980 per year, or $19.22 per arc lamp per year. The combination with the water works saves the salary of one engineer, $65 per month, less extra pay to water works engineers.

The City of Dunkirk, N. Y., installed an electric plant with its water works in 1888. The water works staff had been: Two engineers, $70 each; two firemen, $50 each; superintendent and assistants, $165; total, $405 per month, or, with $350 per year for clerk and collector, $5,210 per year. When the electric plant was added with an additional boiler, a trimmer was employed at $55, and the firemen were given $5 extra pay; total, $65 per month, which, with $133.62 extra labor on lines, made the total labor cost $913.62 in 1897, or $12.18 per arc. As a matter of fact, the Dunkirk labor cost is only $133.62 a year more for both water supply and electric lights than it had been for water supply alone, because one superintendent at $100 a month now does the work formerly done by superintendent and assistants at $165 per month, and the total labor cost for both departments in 1897, including extra labor, was $5,343.62, against $5,210 for water alone before 1888. But this saving of $65 per year in the superintendent's force has been properly credited to the water department, and the extra expense for electric lighting has been figured as above at $913.62.

In considering the cost of operation in these plants connected with water works, the conscientious defender of the higher charges of private plants is justified in pointing out that they cannot be taken as a fair basis of comparison with private plants operated alone. He, however, would hardly go as far as Mr. Francisco and claim that their operating accounts were dishonestly compiled, nor would he adroitly add the water account to the electric account.

The officials in these cities have prepared these statements with a definite purpose, namely to show to other cities having water works plants the very slight additional expense that they would incur by adding an electric plant to their water plant. From this point of view their statements are straightforward and correct. They demonstrate beyond question the decided advantage that every small city with a water plant has in espousing public ownership and operation of electric works, provided the two can be incorporated in one establishment.

There are many small villages now enjoying electric lighting which would probably not have secured this privilege had not the people as a whole, in their corporate capacity undertaken it. Mr. Foster, in reviewing the list of 34 towns whose costs he has tabulated, and showing that 13 have less than 3,000 inhabitants, five have between 3,000 and 5,000, four between 5,000 and 10,000, seven between 10,000 and 20,000, four between 20,000 and 30,000, and only one is of the first class, or over 1,000,000, remarks that "somewhat over half the number are places where it is doubtful if a commercial or private plant could be made to pay under any circumstances." If this is so, the question at issue is not one between public and private ownership, but whether they shall have electric lighting at all. If they have made a success of it, and have produced light at a cost no greater than other cities are paying private companies, this is certainly to the credit of the principle of municipal ownership under such circumstances if under no other.

PREVIOUS INVESTIGATIONS CRITICIZED.

In attempting to make a comparison of the actual operations of municipal and private ownership of electric lighting plants in the United States that shall be at the same time fairly exhaustive and fairly accurate, one is confronted with the magnitude and expense of the undertaking. Nothing less than a governmental bureau can adequately undertake so large an inquiry. It must, therefore, be to the greatest satisfaction of the public to know that the United States Department of Labor, under the supervision of Carroll D. Wright, has undertaken exactly such an investigation. In view of this prospective mine of information, I shall not undertake to consider the whole field, but shall devote my attention to a few municipal plants which I have been able carefully to study personally, and to a critical examination of some of the more important statistical inquiries that

[1]Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec. Engr.
[2]Published by the author, Rutland, Vt., 1895.

have been made hitherto. These are three in number: that of Mr. H. A. Foster, that of Mr. J. Francisco, and that of Prof. Frank Parsons.*

The first two are antagonistic to municipal ownership, while the latter favors the proposition. I have tabulated below the results obtained by these three writers as to the cost per lamp hour and the cost per year of arc lighting in all cases where two or more estimates for the same city are given. These reports are not all made upon the same unit as a basis and I have been compelled to make two sets of computations in order to bring them to the same basis for comparison.

I have selected these three writers because the opponents and the advocates of municipal ownership throughout the country seem to rely upon them for their data and arguments in maintaining their respective opinions. It will be seen that they reach the most contradictory results. Mr. Francisco far exceeds Mr. Foster in his high estimates of the cost of municipal operation, and Mr. Parsons, while his estimates are materially lower than either, is yet in such cases as I have been able to examine, above the estimate made by the municipal officials themselves.

(Table I. will appear in next part of this article.)

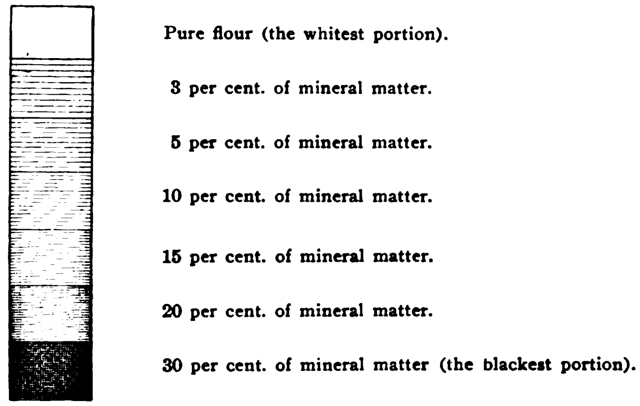
Researches by Means of X-Rays on the Adulteration of Flour.

BY A. BLEUNARD.

DR. LABESSE and myself having had occasion to analyze flour containing as much as 40 per cent. of foreign mineral matter, have tried to discover this adulteration by means of the X-rays, a research which has been made before, but which we wished to perfect and make as sensitive as possible. The nature of the mineral substances present in the flour, consisting of sand reduced to a powder, and insoluble lime salts, principally chalk, we decided a priori to look upon our experiment as one that could be easily performed successfully. The experiment was a complete success when the conditions exist as indicated below.

It is claimed to be difficult to compare the shades when they have great variation, and this is why, in the improvement made by Foucault on the Bouguer photometer, this scientist has obliterated all black or luminous lines, due to the separating screen between the two luminous sources to be compared. We thought of operating in the same manner and to superimpose, on the photographic plate or the fluorescent screen, without discontinuity, the two images of the flour to be compared, pure flour on one side and adulterated flour on the other. To this simple arrangement we owe all the sensitiveness of our method.

We placed on an ordinary photographic plate of gelatine-bromure, a small pasteboard box, of rectangular shape, from which the top and bottom are removed, retaining consequently only the lateral walls, of about one centimetre in height. We divided the box into two equal parts, by means of a small rectangle of convenient dimensions, cut from a visiting card. This done, we then filled one of the compartments with the pure flour, the other with the adulterated flour; we removed with precaution the separating partition, and we lightly tapped the box with the finger, so as to fill up the small empty space which fills



SCALE OF TINTS SHOWING THE ADULTERATION OF FLOUR.

with flour, without sensible mixture. The whole is covered with a sheet of tin foil, with a quite narrow rectangular slit cut in it, and placed perpendicular to the section of separation between the two flours. It only remains to expose it to the action of the X-rays and to disclose the image.

The duration of exposure must not be too long, and naturally depends on the apparatus one employs. Two minutes was sufficient for that which we experimented with. Too long an exposure has the disadvantage of producing too dark tints, the comparison of which is impossible; too short an exposure produces, on the contrary, too faint tints.

This method has permitted us to disclose with certainty the presence of three per cent. of foreign mineral matter in flour, this matter being composed of equal weights of very fine sand and chalk. The adulteration can be detected much easier when the proportion of mineral matter is greater.

Besides, it is possible, once the fraud is known, to tell with considerable exactness the quantity of mineral matter introduced. It suffices to compare the tint obtained with an increasing scale of tints, obtained by introducing into pure flour known quantities of foreign mineral matter. We further wish to remark that the tints vary with the nature of the mineral matter employed in the adulteration, and that this method of quantitative analysis can only be approximate. The accompanying engraving is an exact reproduction of a scale of increasing tints, obtained by placing in succession, in the same kind of a box and using the above precautions, successive samples of pure flour and of flour progressively mixed with mineral matter, such as sand and chalk.—La Nature.

A Rhythmic Dilation of the Heart Discovered by the Roentgen Rays.

A special dispatch from Paris of February 12 says that Prof. Bouchard has discovered a new movement of the heart by means of the Röntgen rays. It is a rhythmic dilation during respiration and is not connected with the ordinary movements of the heart. It appears to arise from a diminution of pressure in the interior of the thoracic cage during inspiration.

GEORGIA.—It is proposed to release the death trap under murderers being hanged by means of an electric push button attachment.

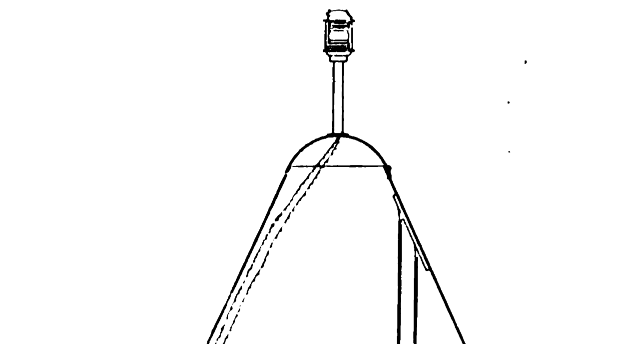
A READER of The Electrical Engineer in Pennsylvania writes us: "Thanks for the sample copy of the paper, but I have been taking it regularly for the past year through my newsdealer. Without any desire to flatter, I consider it the best electrical paper published, and settled down to it as a favorite after a thorough trial of all the others."

*Mr. Horatio A. Foster was employed by the Electrical Engineer to report on an inquiry into municipal electric lighting, undertaken by that journal. His report is published in the issue of September 5, 1894. Mr. Foster is an electrical expert and accountant of high standing, who was employed on the census of 1890, and his report is undoubtedly the ablest and most candid of all the investigations made from the standpoint of those who defend private companies. Prof. Frank Parsons, the results of whose extensive investigations were published in the "Arena" during the latter half of 1895, gives the most painstaking and exhaustive statistical analysis of electric lighting yet made from the standpoint of those who favor municipal operation. While these two writers reach apparently opposite conclusions regarding the cost of municipal enterprise compared with private enterprise, yet their differences are found not so much in the labor cost per arc light as given in Table I. as in their estimates on interest and depreciation. The actual operating expenses, including wages, fuel, stores and supplies, are matters of record stated by the local officials themselves in their annual reports, together with the total unmber of lights operated during the year. Therefore but little variation could occur in computing the labor cost, as will be seen by noting the cases where the two happen to give figures on the same plant. I give herewith all the cities which either one reports. Mr. Foster does not state the cost per year, but he states the cost per lamp hour ond the number of hours per year, and I have computed the cost per year: Mr. Parsons gives only labor cost per year, and not the cost per hour or number of hours. In using these figures, extreme cases should be excluded, as Arlington, Minnesota, and Chehalis, Washington, given by Mr. Foster. In the former there were but four arcs and 100 incandescent lights, and in the latter there were the extra high wages of the Pacific Coast. Where I have been able to examine personally a municipal plant or have made estimates from the annual reports I have so indicated.

MECHANICAL

Fletcher Wave-Power Electric Buoy.

IN our issue dated November 25, 1897, we placed before our readers the details of a wave motor, the invention of Mr. B. Morley Fletcher, Assoc. M. Inst. C. E. We also described tests with this motor in connection with the dismantled barque "Wendla" off Dover, and gave a detailed account of the very encouraging result of these tests. During the recent gales experienced around the coasts of England, we regret to record, the "Wendla" became a victim to the severity of the weather and heavy seas, and was blown from her moorings and stranded on the rocks to the eastward of Dover. The whole of the plant and gear of the various wave motors then on board was, by prompt action, rescued from the wreck, and fortunately the stranding was not attended by the loss of the lives of any of the crew. This catastrophe is the second of its kind that has occurred during the progress of this invention since its inception, and has proved to be a most serious blow to the promoters of the syndicate, but, nothing daunted, Mr. Morley Fletcher, is again quickly to the front with a still further development of his invention in the form of a beacon light, and launch charging buoy, which we now propose to describe.



FLETCHER WAVE POWER ELECTRIC BUOY.

The beacon light buoy is a plain pear-shaped buoy of the ordinary type, as shown in the accompanying illustration, and resembles in form the gas buoy usually adopted by the Trinity Brethren, of which type of buoy there are probably some thousands distributed around the coast lines. The buoy we now illustrate is so designed and arranged as to contain within it the whole installation of the pump, together with the necessary suction and delivery valves, air vessel, turbine, dynamo, etc.; and differs in this respect from the larger power plant previously described in the former issues of this journal, which had its pumping arrangements below the buoy, and a hose connecting the delivery to the attendant vessel, or power station, in order to drive turbines or dynamos. Thus we have in the beacon light buoy, a floating buoy containing a complete installation, fully protected, and furnished with an electric lantern of any desired candle power or brilliancy, fitted in a position well above the surface of the water.

The ordinary gas buoy of the Trinity type is furnished with a light of some 50 candle power, and with respect to its construction, is of a costly character. Apart from this, the upkeep is also very great, as it becomes necessary that a specially constructed launch, or similar vessel, with all its attendant expense of crew, equipment, and the like, should visit the buoy say once in three weeks or once a month at the most, in order to recharge the gas chamber. On the other hand, the latest device of Mr. Morley Fletcher's beacon light buoy, when working at its very lowest power in practically a dead calm sea, may be so designed as to produce electrically a much more powerful light at the head of the lantern than that obtainable from a gas buoy and at a greatly reduced cost. The electrical light may, moreover, if and when desired, be so arranged to flash or glow as required, or be projected through a colored lens in any manner required.

The same buoy may also be fitted to blow a fog horn, or syren; or it may be further utilized for charging an electric launch, or for pumping a column of water delivered at a pressure equivalent to about 600 feet head. The illustration shows diagrammatically an apparatus about to be constructed to the order of The Morley Fletcher-Wave Power System Syndicate, the owners of the British rights in this interesting invention.

The following is a general description of the apparatus: A is the hydrometer tube or spindle of the comparatively stationary portion of the motor, the principles of which we have described at length in former issues. The buoy itself is free to oscillate or move, by the action of the waves, around or upon the spindle. At the top of the spindle, a strong bracket and cross head is fitted, which is connected to the piston rod of the pump B. The pump shown in the illustration is a double acting pump, complete with the necessary suction valves, strainers, and delivery valves. The pump is connected with the receiver or air vessel C, from whence delivery is effected to the turbine or Pelton wheel D, indicated on the diagram, and is coupled with the dynamo E, this in its turn being fixed to a raised circular bulkhead within the buoy. Beneath this bulkhead a large air chamber F is constructed, which is of sufficient cubical capacity to float the whole gear, and thus preserve the buoyancy of the apparatus in the event of water entering the main portion of the buoy by reason of accidental damage or other causes. The illustration shows the particulars and proportions of a buoy rather more than 6 feet in diameter, the details of the machinery being arranged mainly for the purposes of practical illustration. We may also add that the air vessel C has not up to the present been found to be absolutely essential to the plant, and may be regarded as being more or less as an auxiliary to it.

It will be noted that the pump B is so arranged that by shutting off the sluice valve shown at its foot, all connection with the sea may be stopped in the event of it becoming necessary to repair the pump, or even to replace it at sea; or in fact should it be necessary to stop work for any other purpose. This particular buoy is also so designed that, with a minimum of wave movement, it is capable of producing a strong beacon light far more powerful than any illumination obtainable by means of a gas chamber, as the minimum energy developed is about 5 h. p., whereas if the wave movement lifts the buoy through its full stroke fully five times this amount of energy may be generated. It may be asked, what becomes of this surplus energy if 5 h. p. is sufficient to maintain an efficient illumination? The answer is simple; the power is developed, as it were, without extra charge or cost, and the amount wasted is not required, as a bypass containing a relief valve is shown in the illustration through which the surplus water is permitted to escape freely. The pressure at which the water is delivered is determined by the weight of the buoy (which rises and falls by the action of the waves) and the piston area, the dimensions of which are governed

by the desire of a low or high pressure at the delivery. The height of the wave does not affect this pressure, but merely determines the length of stroke of the pump, and the corresponding quantity of water which it forces forward through the pipes fitted for driving the turbine, or for performing other work.

Mr. Morley Fletcher has, during the last few months, added many ingenious improvements to the motor, to one of which we referred in our issue dated November 25 last, whereby an adjustment may be effected, at the water level of the hydrometer tube, by means of an arrangement of a telescopic adjustment cylinder fitted at the bottom end of the tube. There are also certain other detailed improvements which we are not at liberty at present to describe, or to show on the diagrammatical view of the buoy,

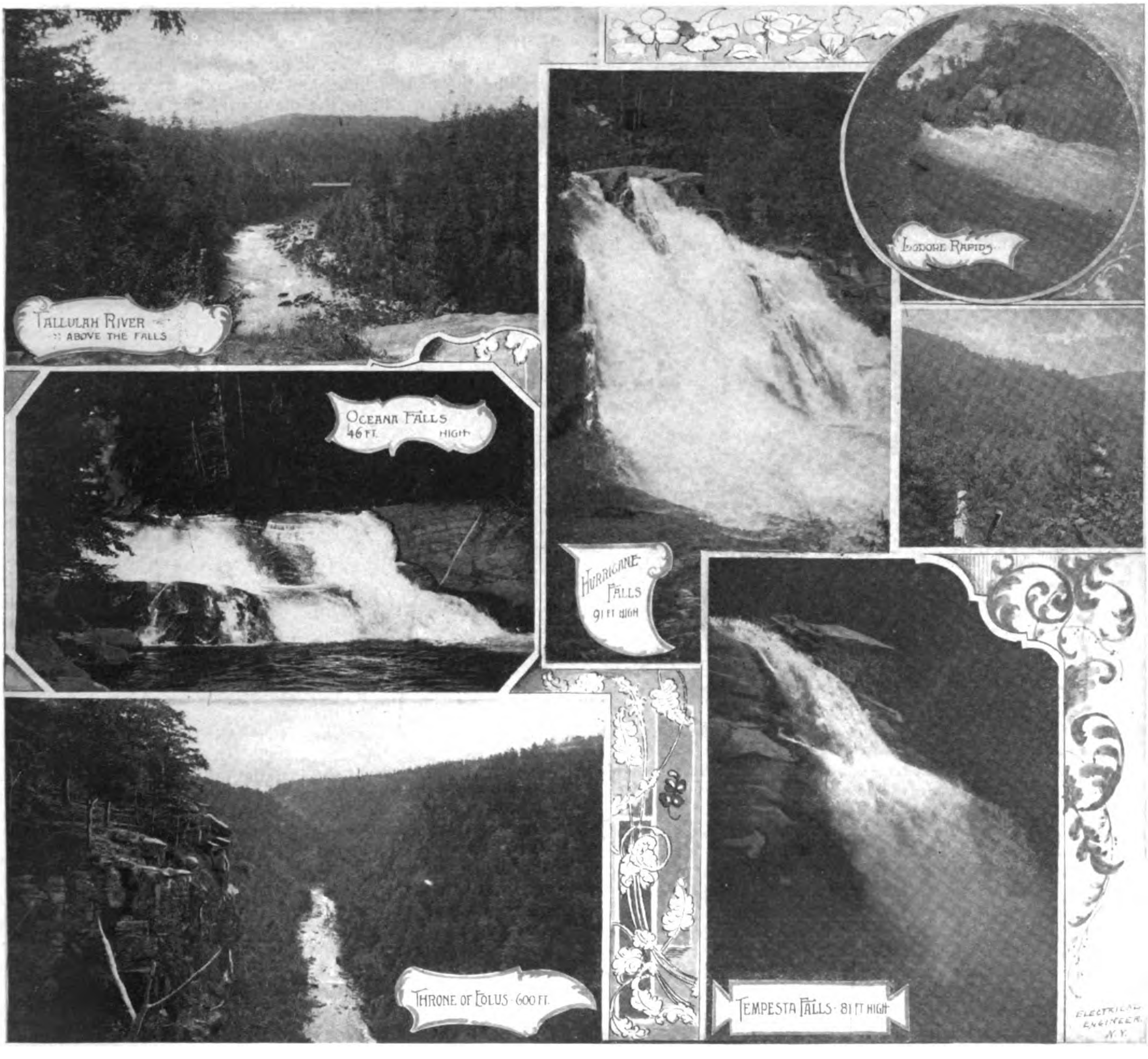
Terminals are provided at the side of the buoy in order that an electrical launch may be moored thereto, and thus receive its charge of electrical energy when desired, thus exploiting an entirely new departure in electric launch work—in fact, the one desideratum the electrical engineer has hoped to procure at sea, viz., an electric current. Means are also provided for ready access, above the surface of the water, to the interior of the buoy, in order that the machinery may be examined, adjusted, and cleaned when necessary, but these are not shown in the illustration, nor are the arrangements whereby the whole of the lower gear, hydrometer tube, submerged resistances, etc., may be raised in order that the whole may be hoisted on board a tug boat or other vessel and easily handled for conveyance to another part of the coast for beacon light or other work. We are indebted to "Industries and Iron" for the above details and illustration.

POWER TRANSMISSION

Utilising Tallulah Falls.—The Niagara of the South.

BY ROWLAND LEE RANDOLPH.

IF there is any one element which determines and promotes industrial advancement it is power at low cost, and no cheaper power can be desired or obtained than that to be derived from waterfalls in our land. Everywhere we find them, some of sufficient size to supply energy to entire cities and towns, others large enough only to furnish power to a single factory or mill.



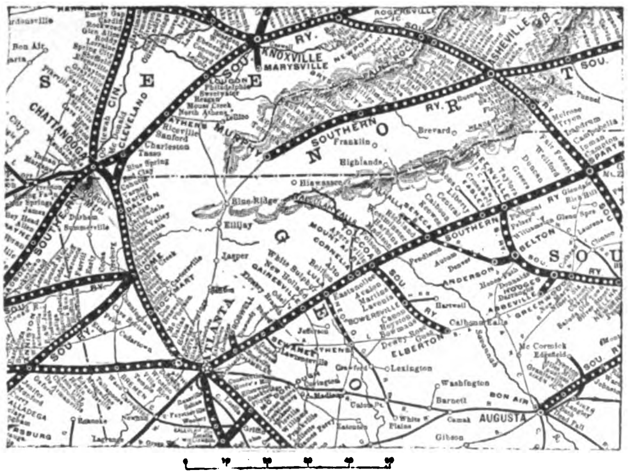
TALLULAH FALLS—THE NIAGARA OF THE SOUTH.

But to rival Niagara, to even adopt this name, means power, beauty and usefulness. All of these requisites are possessed in a marked degree by the Tallulah Falls, so fitly called "The Niagara of the South."

The Tallulah River, which derives its name from the Indian word signifying "Terrible," takes its rise in the mountains of Northeast Georgia, and running through a series of gorges finally finds its way to the Savannah River, of which it is a tributary. The falls of the Tallulah are located about eight or ten miles above its junction with the Savannah, on the dividing line between Rabun and Habersham Counties. The Blue Ridge & Atlantic Railroad, connecting with the Southern Railway at Cornelia, seventy-eight miles north of Atlanta has its terminus at the present at Tallulah Falls, a run of twenty miles. This will soon be continued to Franklin, N. C., shown on the accompanying map, and finally to Knoxville, passing through Rabun Gap, the natural gateway of the Blue Ridge.

As will be seen, the falls are located about equidistant from the large cities of Atlanta, Augusta, Asheville, Knoxville, Sparta and Chattanooga, and to give an idea of the relation of the falls with the Gulf and the Atlantic Ocean the following story may be of interest. Many years ago a government reconnaissance was made of this section for the locating of the Charleston & Cincinnati Railroad. As the party halted on the divide the chief dipped a cup of water from the mountain spring nearby, and drinking, said: "Gentlemen, I pledge you in the waters that flow to the Atlantic," then walking a few steps and filling his cup from another spring, "and now in the waters that flow to the Gulf."

For two miles above the falls proper, the river is a succession of rapids, and the falls themselves, five in number, range from 30 to 100 feet in height. The river banks, which at the uppermost rapids were nearly level with the water, tower to cliffs approaching a thousand feet by the time the last fall is reached. The current is swift; its velocity by a rough estimate, 200 feet per minute. The supply of water is unfailing, as beside its tributaries, the river is fed by many springs.



MAP SHOWING THE LOCATION OF TALLULAH FALLS.

The country in the immediate vicinity of the falls is rugged, promising gold and iron ores, as well as a variety of stone fit for building purposes. Higher up the river, and in the valleys opening from it, the soil is good, and capable of yielding abundant and varied crops. Fruits of all sorts, grapes especially, are easily produced and are of excellent quality. Stock of all kinds can be raised at small expense, requiring little protection in winter, and the miles of untouched woodland furnishing them ample pasture. The sheep are remarkable for the fine quality of their wool, and the delicate flavor of the meat. The hams cured from the hogs of this section rival the celebrated Westphalia. From the extensive forests lumber is to be procured. Springs of the purest water, and also mineral springs, are numerous. The region of the Tallulah Falls, in a word, presents all the requisites and facilities for a great manufacturing center, and can support a large population.

The scenery of the Tallulah Falls is grand and romantic beyond description. From favorite points of view may be seen, in the foreground, the deep and terrible chasm of the falls, with the eagle floating far below; and beyond, stretching out for miles, an ocean of beautiful country. The climate, even in summer, is of an invigorating and bracing quality, and for years Tallulah has been the resort of the health-seeker as well as of the lover of nature in her sublimest moods.

Since the completion of the railroad to Tallulah Falls a small town has sprung up. There are several hotels, three or four stores, a post office, and on the higher points about the settlement some pretty villas, which in summer are occupied by their city owners.

Although no definite figures can be given regarding the depth and width of the stream, on account of no accurate surveys having been undertaken, it can be authoritatively stated that the minimum depth of the river is over 15 feet at any time of the year. An idea of the power can be gained from the above illustrations, which show the comparative widths and heights of the falls and rapids. It is expected that this unused and unusually large and well situated water power will soon be harnessed and used for the numerous new industries which are continually being inaugurated and developed in the surrounding country and nearby cities, as well as for railroad work in this region and for mining operations.

Further Extension of the Niagara Power House.

THE interior of the central station of the Niagara Falls Power Co., is now the scene of great activity, men being at work installing the new turbines and Westinghouse generators which it is intended to add to the plant in order to increase the capacity from 15,000 h. p. to 50,000 h. p. The partition between the old and the new sections has been removed and the two parts of the dynamo room thrown into one. In the picture herewith presented the addition to the dynamo room may be seen by the dark girder to the left over the windows, the light part being of the original section. Far down at the other end is to be seen the 50-ton electric traveling crane used to raise and lower the heavy parts of the installation into place, while in the foreground are the three dynamos now in operation. The floor of the station, in the picture, is well covered with boxes and packages containing parts of the new installation, but when all is in place the dynamo room will return to the orderly state for which it is noted and for which it has been so much admired by visitors. It will not be very long now before dynamo No. 4 is in operation, thus giving the power company an additional 5,000 h. p. to meet the heavy demand made on them for current.

VIEW OF NIAGARA POWER HOUSE.
(Showing Further Extensions in Progress.)

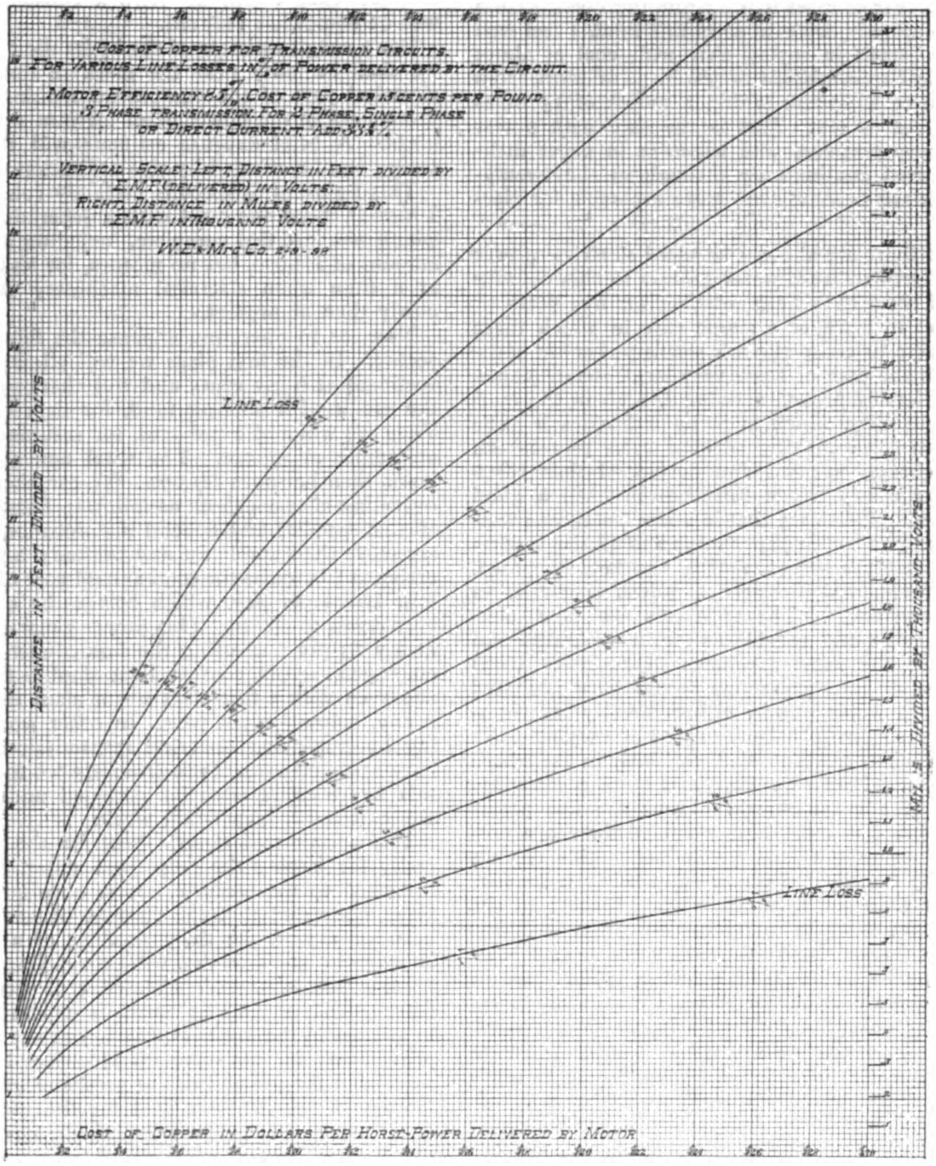
A 108 Mile Transmission.

The one-hundred-and-eight-mile electric transmission plant is again under consideration in Southern California. The undertaking involves the erection of a dam across the Kern River, in Kern County, Cal., and the construction of a line to convey the high tension current to Los Angeles. The Kern River drains an area of some 2,345 square miles, and a total of about 12,000 horse-power can be obtained. A pressure of 30,000 volts is proposed for transmission. While this is exceptionally high,

the dry atmosphere and infrequent rainfalls warrant its adoption. The dam will form a storage reservoir, with a volume of about 13,721,400,000 gallons or the equivalent of 42,000 acre-feet. Should the project be carried out, it would be by far the longest electric power transmission line in the world.

Curves Showing Cost of Copper for Transmission Circuits.

IN the course of a very interesting and highly instructive lecture on "Electricity in Paper Making," before the American Paper and Pulp Association, Mr. Charles F. Scott, electrical engineer of the Westinghouse Elec. Mfg. Co., presented the curve given below, which is both novel and useful. It enables one to find the cost of copper for transmission circuits with any given percentage of line loss, the distance in feet or miles, and the voltage. The lecture was a very exhaustive résumé of the principles and practice of power transmission, with special reference to the application of electric power to the paper-making industry. The curve is, of course, useful in any branch of the application of electrical power for transmission purposes.



CURVE GIVING COST OF COPPER FOR TRANSMISSION CIRCUITS.

MOBILE SHIP CHANNEL.—Capt. R. D. Evans, chairman of the Lighthouse Board, favors electric lighting for the Mobile Ship Channel, but proposals have been asked for Pintsch gas distribution.

Use of Electric Motors in Paper Making.[1]

BY DR. LOUIS BELL.

NUMEROUS paper mills have to face the dilemma of paying heavy freight bills on their raw material or producing their power by steam where the cost of coal is high. Inasmuch as steam is needed in the process of manufacture it is quite usual to drive part of the plant, particularly the Fourdrinier machines by engines, using the exhaust steam for heating purposes.

Now, at the risk of being accused of "teaching my grandmother to suck eggs," I am going to enter a vigorous protest against this practice. It is most emphatically not true that steam thus obtained is cheaply obtained. It implies in the first place very uneconomical use of the engines, and, in the second place, it virtually amounts to generating steam for heating at a high pressure and reducing this to 8 or 10 pounds by the use of a very expensive reducing valve. It is well within bounds to say that the fuel bill for the power is doubled by thus working the engines non-condensing with considerable back pressure, and the cost of the steam used for the heating is thus really a most unpleasant item. For example, take a plant requiring 10,000 horse-power hours per day, and 50,000 pounds of steam for heating purposes. If worked in the common way there will be required for power not less than 300,000 pounds of steam, de-

[1]Extract from a paper read before the New York meeting of the American Paper and Pulp Association, Feb. 17, 1898.

manding burning, say 20 tons of coal under the boilers. Working condensing the same power can be obtained for about 180,000 pounds of steam, say for 12 tons of coal, while the extra 50,000 pounds of steam for heating call for about 3 tons more, making a total of 15 tons daily. A demand for heating capacity so great as to render the power generation a mere accessory would only show very bad utilization of the heat.

In my opinion the first and greatest use of electrical apparatus in paper making is in supplying cheap motive power from waterfalls, enabling the mills to be located at points favorably situated with respect to cheap raw material and easy shipment of product. These advantages once gained the power can be delivered from the nearest available waterfall at a cost generally lower than the local cost of steam power.

It must be distinctly remembered that power thus transmitted electrically is not at all necessarily cheaper than steam power, but in a very large number of cases it is. From the investigation of probably several hundred propositions of this kind, I feel well within the bounds of truth in saying that with coal at about $3 per ton the electrical transmission of 500 h. p. or more from an average water power anywhere within a radius of 15 miles will pay nine times out of ten. This is the case with power transmitted for ordinary purposes, and when, as in paper making, power is often used continuously throughout the twenty-four hours, the conditions become even more favorable for electric working.

At the present time there are above a hundred electrical power transmission plants operated from water powers in this country alone. A number of them have been working for five years or more, and I have yet to learn of a single case in which these plants have been unable to compete with steam power on satisfactory terms, save in the case of some very large steam plants. Transmission has uniformly proved successful, both in the matter of cost and in reliability, which in many industries is quite as important. And in paper-making regions water powers can generally be more cheaply secured and developed than when they are located near a city which furnishes in itself a good market for power. I am glad to say that in a few instances transmitted power is actually in use in paper mills and all the reports received seem to indicate the success that was to be anticipated. There is nothing experimental in electrical power transmission under ordinary circumstances. The apparatus as now constructed is as manageable and reliable as steam apparatus and may be installed with the same assurance of success. Until within the past three or four years one would have hesitated to advise driving from water power, either directly or indirectly, any machinery requiring uniform speed at varying load. Now, however, water wheel governors are regularly in use which are able to hold the speed with an exactness quite comparable with the governing of a good engine. There are few places where uniformity of speed is more highly valued than in a cotton mill, and there are now a half dozen large mills relying entirely on electrically transmitted power—and using it because it is actually cheaper than steam power, although some of the very best steam practice is to be found in the cotton industry.

I can in no way better emphasize the dollar and cent side of the problem than by making an estimate for a typical case of the kind. Let us assume that one of you has a mill which requires, say, 1,000 h. p. delivered continuously for all purposes. Near the proposed site of the mill there is merely a stream big enough to supply water for general purposes, but 10 miles away is a good water power which can be secured without unreasonable expense. What will be the cost of the power transmission plant necessary to do the work?

To begin at the power house, we must allow, say, 1,000 kilowatts in capacity, with preferably a generator in reserve, say three 500 kilowatt direct-connected machines, if the speed of the wheels will allow. The market price of such machines, complete with station equipments, and wound for 5,000 or 6,000 volts, including installation, will not exceed $10,000 each. It is almost unnecessary to state that for a transmission of this length one of the polyphase systems would always be installed. The present tendency is toward high voltage generators, connected directly to the line for such cases, although low voltage generators with raising transformers can be obtained for not far from the same price. In any event, reducing transformers for 1,000 h. p. would have to be installed at the mill, in large units of which the aggregate cost would not exceed $5,000 to $6,000. The 1,000 h. p. in motors would be needed for driving the various parts of the mill, and assuming units of 100 h. p. or more the probable cost of these motors would be $15,000 to $20,000, depending somewhat on the size and speed of the various units. This completes the necessary electrical machinery. The line, assuming say 6,000 volts delivered and 10 or 12 per cent. drop, could be erected with all copper up for less than $20,000. Altogether, the machines at both ends of the line and the line itself could be installed, including a suitable station, for about $80,000; under favorable conditions for somewhat less.

The cost of the water privilege and the necessary hydraulic work is the most uncertain factor in working out any assumed case of power transmission. It may fall even to $25 or $30 per horse-power, and it may rise to $150 or $200. Taking the general average of powers in regions where they have not yet acquired an artificial value by proximity to towns, one may say without being widely astray that $75 per horse-power will cover the necessary expense. With a considerable head this figure will be somewhat reduced.

For a rough estimate of the hydraulic cost in the case in hand, we shall be fairly near the mark in doubling the cost of the electrical part of the equipment, making $160,000 as the total investment in the power plant for furnishing 1,000 h. p. day and night. A brief expense estimate will show how important a saving can be effected by this utilization of electric power.

This figure of $160,000 is certainly conservative enough, since I have in mind one plant with a generating station of 1,000 h. p. which was installed complete, including distribution lines to the amount of $15,000, but no motors, for less than $125,000 and this at a time when electrical machinery was considerably more costly than at present.

Now, as to operating expense the figures are not difficult to secure. In the first place we will allow for interest on the investment at 6 per cent., and will charge annually 4 per cent. to the credit of a sinking fund, for depreciation or replacement. Then we will add 2 per cent. for insurance and taxes—certainly an ample allowance. The total annual charge due to these items then becomes $21,600. We can then make up the regular operating charges about as follows: Labor, eight men and team, $6,500; supplies and general maintenance, $5,000. These figures are more than ample for any ordinary case. Summing them we arrive at $33,100 as the total annual cost of 1,000 h. p. for twenty-four hours per day, which brings the charge per horse-power year down to $33.10. This power generated by steam, with coal at say $3 per ton, using the non-condensing engines too often employed, would cost at least double the amount mentioned, and even with a first-class steam plant the cost would fall little, if any, below $50 per year. In other words, the net yearly saving by employing electrical transmission in such a case as we have assumed amounts to from $15,000 to $30,000 per year. And this figure could often be exceeded under the conditions actually existing in paper-mill work.

The question of electric heat for the drying rolls, and generally for freeing the pulp from water, has been several times broached to me recently, It is only fair to say right now to those interested that the amount of power required to furnish heat for drying the daily product of a modern paper mill is enough to stagger the wildest-eyed and longest-haired electrical crank who ever claimed that electricity was in its infancy. That drying by steam is expensive is painfully evident to anyone in the business, but if you are minded to seek for improvements do not take up electrical heating until you have exhausted the possibilities of producer gas.

To sum up, the best field for the use of electric motors in paper manufacture is in reducing the cost of power, by utilizing the now well-tried methods of power transmission. By this means a mill can be located so as to obtain its material and ship its product economically, without foregoing the advantages of cheap water power. With the transmitted energy at hand, power can be economized by the skilful use of motors in its distribution. There is no cut and dried rule or formula by which the best equipment can be at once determined. Each case has to be considered on its merits, and by the light of common sense, for in the last resort the best equipment is the one which enables you to turn out a given grade of paper at the lowest price.

GERMAN ELECTRICAL STANDARDS.—The "Frankfurter Zeitung" announces that, during the present session of the Reichstag, the draft of a bill regulating electrical standards will be presented for consideration.

LITERATURE

PRACTICAL CALCULATION OF DYNAMO ELECTRIC MACHINES. By Alfred E. Wiener, E. E., M. E. New York, 1898. The W. J. Johnston Company. 683 pp. 6 x 9 inches. Cloth. Price, $2.50.

To criticise a book that gives evidence of so large an amount of labor, applied in so painstaking a manner, is a very unwelcome task. The book is evidently intended for that large class of young men that is making strenuous efforts to learn how to design, in the hope of improved positions and a better class of work; hence, to allow a work so full of errors, misconceptions, and false methods to go to these men, in most cases unable to differentiate the incorrect from the correct, without disclosing its defects, would be almost a crime.

Its author appears to have collected a heterogeneous mass of data from all available sources, and then tabulated the results, without having stopped to discriminate between the good and the bad. This raw, undigested mass he has thrown into book form, with a few connecting reflections of his own, many of the latter showing a misconception of the principles involved. This he has offered to the public with an assumption of authority likely to give those not conversant with the subject the idea that he is master of it.

The very title itself is misleading, since it includes much more than is treated of in the book, wherein only direct current dynamos and motors are discussed, defining thus only a small part of the field included in the title. Many general statements are made without qualification that can, in fact, be applied only to one of the classes of machinery treated; for instance, the first paragraph on page 34, which applies to smooth core machines alone; incidentally, it is incorrect for them also.

The method of design recommended is empirical, and is based on given tables, furnished by the author, as having been tabulated from the data of a large number of machines. Most of these tables, so far as I have examined them, are more or less inaccurate. For example, those on pages 52 and 54 are not in accordance with the best modern practice. Table VI., page 54, is especially impracticable, inasmuch as densities do not increase with the size in regular gradation as there shown; furthermore, the densities in many cases are much higher than is therein stated.

The length of inductor, which is the first part of the design settled on, is determined by these tables and their inaccuracy accordingly renders the whole design uncertain. The length of inductor should not be based on such tables in any case, but is dependent on considerations of armature reaction, heating and sparking limit and economy of design. Many other incorrect laws, tables, and statements might be cited, but space and time do not permit me to point them out. I will mention only one or two of the most obvious, taking them at random.

The law stated on the first page of Chapter III., in the fourth paragraph, should not include the length and cutting speed of the conductor, since the e. m. f. is proportional to the number of lines of force cut in a unit of time entirely independently of the length and cutting speed.

On page 35, second paragraph: "The extra bars are properly cross-connected to the active bars." Such bars are generally not cross-connected, and, in any case, they are all active, and none of them is extra. Nearly the whole of paragraph 18, page 53, is incorrect.

As to the last paragraph on page 30, commutation has no effect whatever on magneto-motive force, and if the lead required for reversal is meant, instead of commutation, the effect on the magneto-motive force of generators and motors is exactly the opposite of that stated. The statement at the bottom of the page, beginning: "Iron is very sensitive to slight increases of magneto-motive force," is not true.

Enough, however, has been said to show that the book is wholly unsuitable for students by reason of its errors and false methods. There doubtless may be much that is valuable in the book, but the busy man has not time to test the data given, and, on the other hand, the student has not the necessary knowledge and experience. As to printing, plates, and binding, the book is well gotten up. THORBURN REID.

STANDARD WIRING FOR ELECTRIC LIGHT AND POWER. By H. Cushing, Jr., electrical inspector for the Fire Underwriters' Tariff Association, of New York. Published by the author. 116 pp., 30 illustrations. Flexible leather. Price, $1.00.

The 1898 edition of this handbook has been completely revised to date and contains the National Electrical Code explained and illustrated with new engravings, illustrating the safest and best methods of installing dynamos, motors and all styles of inside and outside wiring for light and power. One of the most attractive features of the book is its simplicity and clearness of wording, together with its numerous wiring tables for ascertaining just what size of wire should be used for any class of wiring without having to resort to any calculation whatever or to the use of formulæ. This work is now regarded as among the authorities for safe and economical wiring and should recommend itself to electrical engineers, central station men and contractors throughout the country.

MUNICIPAL OWNERSHIP VS. PRIVATE CORPORATIONS. By M. J. Francisco, Rutland, Vt. M. J. Francisco & Son. Paper, 150 pp. Price, 50 cents.

This is the fifth edition of a remarkably interesting book. The author's attitude as a defiant opponent of municipal ownership is well known, for he goes the full length of his feelings and convictions. He gives plenty of reasons, however, for the faith that is in him, and presents a most formidable array of data, as well as many records of municipal plant failure. The book is one which can often be distributed with useful results.

ALGEBRA MADE EASY. By Edwin J. Houston, Ph. D., and Arthur E. Kennelly, Sc.D. Published by the American Technical Book Co. New York, 1898. Price, 75 cents.

The title of this little volume may be somewhat misleading, in that it is not a general treatise on algebra, but has rather a special mission to perform, and contains besides algebraic instruction, chapters on trigonometry and differential and integral calculus. The book has been prepared for the purpose of elucidating the mathematical formulæ appearing in the pages of Prof. S. P. Thompson's "Dynamo Electric Machinery" and "Polyphase Electrical Currents." We believe that the authors have succeeded in presenting the matter in such form as to enable a non-mathematical reader to read the two books intelligently. It only seems a pity that it is necessary to compile such a key to books which contain topics of such vital interest to all electrical engineers as those named above.

HOW TO BECOME AN ELECTRICAL ENGINEER. The Electrical Review Publishing Co., New York. Pamphlet size. Price, 25 cents.

This little brochure is a reprint of a series of prize essays contributed to the columns of our esteemed contemporary, "The Electrical Review." The ideas embodied in these essays ought to be of great value to aspiring electrical engineers, and the suggestions as to the proper course to pursue may save much time and trouble. Appended to the essays is a list of colleges in the United States giving electrical engineering courses.

ELECTRICITY AT THE COLUMBIAN EXPOSITION. By John P. Barrett, chief of the Department of Electricity. R. R. Donnelly & Sons Company, publishers. Chicago, 1894. Price, bound in cloth, $1.00.

This book contains eigthy-four handsome full page illustrations, sixteen of which show exterior views of the buildings at night. The brilliant illumination of the buildings by both incandescent and arc lights made it not only possible to photograph them after nightfall, but also gave unique and artistic results. Seventeen of the full page illustrations are general views giving pictures of the fountains and statuary and there are also fifty full page pictures of the various exhibits. The paper used in this book is finely finished enamelled book paper which allows for the best effect in printing illustrations. The text is generally descriptive of the various exhibits and of the buildings and also contains several reports on the expenses and the operation of the intramural railway, and several short historical introductions to the descriptions of the various departments of electricity. The Western Electric Company has bought up the entire edition left on hand, and is now disposing of it at the above price.

THE

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The Use of the Electric Motor in Paper Making.

A VERY interesting and timely series of papers was read before the American Paper and Pulp Association at their annual meeting held in New York, February 16 and 17, 1898. They dealt with the use of the electric current in paper making and in pulp manufacture, and presented many novel and useful phases of the subject. Steam, water and electric power were compared by men of competence and experience in a broad-minded and unbiased manner, and the papers by Drs. Bell and Emery and Mr. Scott constitute by themselves a complete treatise on the use of electricity in the above-mentioned arts. We present in another part of this issue an abstract of Dr. Louis Bell's very interesting paper on the use of electric motors in paper making, wherein he enters a vigorous protest against the use of exhaust steam for heating purposes in paper manufacturing establishments. He claims that it implies, in the first place, very uneconomical use of the engines and, in the second place, it virtually amounts to generating steam for heating at a high pressure and reducing this to 8 or 10 pounds by the use of a very expensive reducing valve. However, in support of the practice of locating paper mills near waterfalls he says: "In my opinion, the first and greatest use of electrical apparatus in paper making is in supplying cheap motive power from waterfalls, enabling the mills to be located at points favorably situated with respect to cheap raw material and easy shipment of product." Mr. Chas. F. Scott, in his paper on "Electricity in Paper Making," made the astonishing statement that nearly 1,000,000 h. p. is being employed in the manufacture of pulp and paper in the United States and Canada. The common sources of power are waterfalls and steam, both having other functions to perform besides supplying power. Regardless of this fact, however, there is a distinct and useful field for the electric motor, whose adaptability for paper and pulp factories is so apparent that it is rapidly replacing direct power derived from steam and falling water. The machine which cuts the rags in the preparation of rag stock, the slowly rotating boiler in which the rags are cooked, the sawing, barking and cutting wood into chips, the driving of revolving stones, are all operations performed in different processes of paper making which can evidently be operated by electric motors. The quantities of power required vary from a few horse power to several hundred horse power, and there are no exacting requirements as to variation in speed; there is, therefore, nothing novel nor peculiar in the application of electricity to such work. In the paper mill proper power is used from start to finish, and in the larger and best arranged mills must be distributed over a very considerable area, which requires in general heavy shafting, many gears and much belting. Mr. Scott then referred in detail to the advantages in the use of electric motors for these operations and especially to direct-connected motors for the machinery in paper mills, citing in support of his arguments in favor of the use of electric power several large and successful establishments. The plant of S. D. Warren & Company's Cumberland Mills, for example, shows an efficiency of 77 per cent., that is, for every 100 h. p. mechanical output of the turbines the motors deliver 77 h. p. to the machinery at the mills. The alternating current using induction motors seems to be the one most commonly employed. Several interesting tables showing the approximate power required for different pieces of apparatus used in paper mills are included in the discourse, which, after having shown to what uses electricity may be put in the manufacture of paper, concludes by enumerating the uses of paper in the manufacture of electrical apparatus.

Mr. Scott also presented at that meeting the very useful curves for calculating the cost of copper for transmission circuits, which we print on another page of this issue. Certainly no better steam authority could challenge the arguments presented by the above speakers, and expound the economical use of steam in the manufacture of paper, than Dr. Chas. E. Emery. After giving an exhaustive treatise on the generation and utilization of steam, Dr. Emery desired to warn his hearers that "for all ordinary purposes, electricity is a luxury. Still we Americans like luxuries and can afford them;" and regarding the use of the electric current he says: "Local electric transmission has its advantages where the points at which power is to be delivered are widely separated, and it is practicable by means of high tension electric currents to transmit power, for instance, from a waterfall for long distances, utilizing at the end of the line generally more than one-half the power generated. Where water power is cheap and abundant this is desirable, as the annual cost will only be the interest on the installation added to the cost of maintenance. Under other conditions, hold fast to what you already know to be good." To determine this, it is safe to turn to the opinions of those who have made a thorough and exhaustive test of all existing methods and be guided in the selection of a system by the experience gained by these men. One of these is the Hon. Arthur C. Hastings, the general manager of the Cliff Paper Company, at Niagara Falls, who refers to the electrical operation of his plant in the following words: "I believe it would be economy for any new mill to equip itself with a central station for the development of its power electrically and distribute it through the whole plant by motors, thereby saving putting in shafting and belts, and ofttimes losing power through running a great deal of useless shafting, besides saving in other ways, such as oil, fuel and attendance." Altogether the meeting of the Association may be declared a pronounced success and the papers presented of great value to the electrical and paper making industries, for in the words of Dr. Emery, "People must get away from the humdrum of everyday life once in a while, see what others are doing, hear what others have to say, and then determine for themselves as they would for another individual what it is for their best interest to do; and do it."

Victimizing Great Inventors.

ONE of the neatest epigrams ever coined in regard to a newspaper has been that which says: "When you see it in the 'Sun,' it's so." A complementary but uncomplimentary phrase might well be applied to many other of the daily journals to the effect that "When you see it in the ——, it is not so." The recent war scare is but one example of the manner in which the absurdest lies and wildest exaggerations can be given out to the public as truthful news; and it is creditable to the press in general that such disreputable instances of yellow journalism are few and far between. The enterprise of these sensational papers is their saving virtue, but even their large expenditure of money and men they do not know how to handle to the best advantage.

But it is not alone in "war news" that the worst productions of these papers have lately been seen. The field of new invention is particularly interesting to them, and the personality of a great inventor offers peculiar charms to them as a theme around which to weave imaginative yarns. Of late Mr. Edison and Mr. Tesla have suffered greatly from the efforts made to describe their work in the lurid columns of the Sunday issues; and the effect of seeing a thing in print is such that we have no doubt both of these inventors have suffered in the estimation of the respectable public from the manner in which their names have been associated with all kinds of foolish and crazy stories. Sometimes the articles have a genuine interest, but even then the points are made so vaguely, it puzzles people to find out just what the real idea is.

All this might not be so bad, however, but when a man is made responsible for long, "continued" stories, patience is at an end, and thus it was that recently Mr. Edison felt called upon to issue a public denunciation of the use of his name in connection with a fiction running in a New York evening journal and other papers, describing an attack from the earth on the planet Mars. But the story went on appearing all the same. Mr. Edison has always been known among the reporters as an "easy mark," he is so obliging and willing to help them satisfy, if possible, the orders of the city editor; but when his good nature is abused in this fashion he is likely to become less approachable, especially as the liar keeps shifting his energies from one subject to another. Only a week or two ago, a story went around the papers circumstantially as to the remarkable qualities possessed by Mr. Edison's magnetic ore; and an English contemporary has just been sarcastic over it at Mr. Edison's expense. We are now informed that, as was suspected, it is another newspaper lie made out of whole cloth.

An equally flagrant case is that of Dr. Elisha Gray, so well known for his many electrical inventions and the organizing president of the International Electrical Congress of 1893. It has been given out with the fullest circumstantial detail that this distinguished man had gone all to pieces financially, and was in the sorest straits. The public was invited to gloat over his agonizing struggles to keep the wolf from the door. Then as a fine touch it was added that he was dying of it all. The whole thing is a most outrageous lie. It is true that Dr. Gray suffered from the panic of 1893 and the prolonged depression, but that has not been an unusual or exceptional experience, and the Doctor is not "stripped of everything," nor has he been cheated and swindled of every dollar; nor is he living in abject poverty, nor has he had to sell his art treasures, nor is he now taking boarders for a living. Dr. Gray occupies the same house that he has been living in for 26 years at Highland Park, Ill.; he is still surrounded by all his "art treasures," and his library is intact and just as sacred to his own use as it ever was. We believe the "boarders" are his own daughter, her husband, and a grandchild, in whose company and sunshine the Doctor takes natural delight.

The whole miserable story appears to have sprung out of a wish to boom some literary work that Dr. Gray had done upon invitation, for the newspapers, dealing with electrical questions in a series of articles. The "scare head" way to interest the public was to write up, or rather "write down," the author, in a sensational and vulgar style, no matter how indignant he might be or how severely his friends' feelings might be hurt. We have no doubt Dr. Gray has protested vigorously against such abominable methods in the proper quarter; and we now venture to offer our own comments, merely adding in conclusion that one benefit of such annoying episodes must be to help prove to a man that if he is really undergoing trials there are some who will hasten to stand by him.

Welsbach Electric Incandescents.

AN item is going the rounds of the press to the effect that Dr. Welsbach, of Welsbach lamp fame, is now at work on a filament intended for electric incandescent lamps, in which the rare earths of the Welsbach mantle are applied to increase the illuminating power. No details have as yet been made public, nor have the results of any tests been vouchsafed. While we have never been numbered among those who believe that the Welsbach gas lamp can seriously interfere with the progress of the electric incandescent lamp, we are always glad to note any attempted or proposed improvement on the latter, which may enhance its economy. As far as the application of the rare earths to incandescent electric lamps is concerned, the idea has been harbored for a long time and has led to experiments at the hands of several workers. Indeed, we have seen such lamps burning. The economy of these lamps was very high, taking into consideration candle power for energy expended; but their life was uncertain and they developed defects which made their use in practice inadvisable. The lamps being experimental, the cost of manufacture on a large scale was not determined. But even if the cost were higher, the efficiency shown by the lamp would counterbalance an appreciable augmentation in this respect. As to the cost of the rare earths themselves we do not believe that this will stand in the way of their application to electric lamp filaments. The demand created by the Welsbach gas mantle is sufficient proof that these materials can be obtained in commercial quantities at commercial prices. We need hardly point out, in this connection, that the actual cost of manufacture of the present Welsbach mantles bears but a small ratio to their present selling price. Notwithstanding the non-success of the rare earth filaments, which have thus far taken the shape of a deposit on a carbon filament, it does not follow that Dr. Welsbach's new filament labors under like disadvantages; indeed, it is to be hoped that he has successfully solved the problem as to cost and life. The plain carbon filament incandescent lamp has been brought to a high state of perfection, but the limitations of temperature to which it is necessarily subject, must preclude any radical improvement in the future. If, however, without increasing the temperature, or even at a lower temperature, we can act upon other incandescent bodies such as the rare earths, a distinct step forward will have been made.

On Antiquated Data.

WE are printing the reply of Prof. Commons to Mr. R. R. Bowker's article against municipal ownership chiefly because it is right to let both sides be heard. But it seems to us it would be better if Prof. Commons could give the public modern facts instead of antiquated data. It is complimentary to us, of course, to have him quote the Foster statistics compiled for The Electrical Engineer four years ago, but since Mr. Foster is still bringing new material to light, and since other material has been available it would be better to use it. For example, Mr. Francisco's book is now up to its fifth edition, but Prof. Commons hardly appears to be aware of the march of events in this or other respects.

It will be noted that Batavia and Dunkirk, N. Y., again crop up, those moss-grown examples of wonderful cheapness. We would like to direct Prof. Commons' attention to the recent data of Mr. Foster in regard to those two plants, which is unchallenged. The city of Tonawanda, N. Y., on that report has just decided to take service from the local company at $.0195 per lamp per hour, instead of putting in a municipal plant. The wisdom of the taxpayers, voting against municipal ownership about 5 to 1 is shown by the data from wonderful Batavia and Dunkirk, in Mr. Foster's very careful report. They compare thus:

	Per lamp per hour.
Tonawanda (private)	$.0195
Batavia (municipal	$.0204
Dunkirk (municipal)	$.0213
To which may be added:	
Braintree, Mass. (municipal)	$.0455
Danvers, Mass. (municipal)	$.0329
Marblehead, Mass. (municipal)	$.0239
Middleboro, Mass. (municipal)	$.0400
Peabody, Mass. (municipal)	$.0220
Reading, Mass. (municipal)	$.0553
Wakefield, Mass. (municipal)	$.0752

Such data as this, which is all in the more recent records, and official at that, goes to show once again that it is better policy for a municipality to hire service rather than try to supply itself.

Equipping the Brooklyn Elevated.

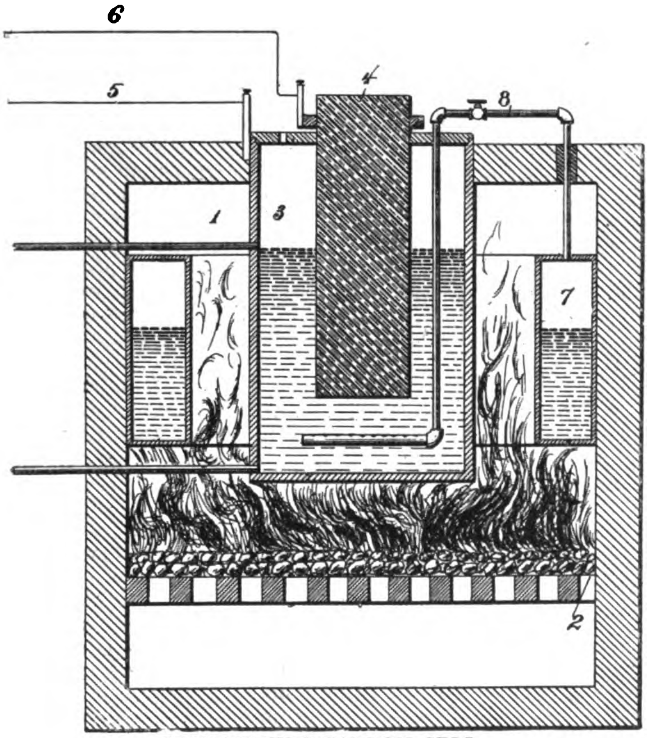
IT must be a source of satisfaction to every electrical engineer to see that at last the elevated roads of Greater New York are to be equipped with electricity. The start is made in Brooklyn, but it begins to look as though nothing would be done in the Borough of Manhattan until change by the chapter of accidents removes the chief obstructionists from power. The foolish nonsense talked by some of the owners of the Manhattan system as to electricity being still in the experimental stage may perhaps be attributed to ignorance. That at least is a charitable view. Meantime the value of the property is relatively, and we think actually running down.

Brooklyn is certainly to be congratulated, and felicitations must also be extended to those who have captured this big initial contract. It is interesting to see the departure made from apparatus of the time-honored locomotive type. Each car is to be equipped with its own motors, and the train can be built up with from one to ten units, indifferently and without regard to end relation. The apparatus has already been put through its paces in Chicago, and the method of control has also been tried there.

MISCELLANEOUS

The Blumenberg Carbon Consuming Cell.

THE problem of transforming potential energy of carbon into electrical energy is one of such universal interest to the electrical engineer of to-day, and the number of competent men engaged in the development of cells and furnaces for accomplishing this result economically and practically, is so large that every improvement, every new device is followed with curiosity and may throw new light on the solution of this great question. A recent process, which we are about to describe, is the invention of Mr. H. Blumenberg, Jr., of New York, for which a patent was granted February 15, 1898. The invention consists of supplying an excess of oxygen to the fused electrolyte by means of superheated steam. In order to hold the oxygen within the electrolyte either chemically or mechanically a fused electrolyte, consisting of lime, cryolite and caustic soda is used which gives excellent results, when they contain oxides or oxygen bearing compounds and steam is injected when it is fused. The position taken or assumed by the metallic oxides or oxygen-bearing compounds seems to be the following: They



BLUMENBERG CARBON CELL.

give up part of their oxygen to the carbon, or, in other words, combine with the carbon, forming carbonic oxide or carbonic dioxide, as the conditions will permit. They then seem to absorb or combine with the oxygen produced from the decomposed steam.

Referring to the figure, the apparatus devised by Mr. Blumenberg consists of a combustion chamber 1, in which there is a grate or burner 2, designed for heating the chamber, and an electrolyte-containing pot 3, perferably of either cast-iron or copper. An anode 4, of carbon or carbonaceous material, is placed in this pot, care being taken that the anode is not in contact with it, to prevent short circuiting. The electrolyte, bath, or conveyer and the oxygen-bearing compound are also placed in the pot. One of the conductors 5 is attached to the pot and the other conductor 6 to the anode 4, preference being had not to introduce the steam until after the conveyer is fused. The steam may be introduced from any suitable generator; but it is preferred to provide a jacket 7 or other suitably shaped reservoir within the combustion chamber 1, in which steam is generated. 8 indicates a steam pipe leading from the jacket 7, preferably into the bottom of the pot 3. The carbon will when heated combine with oxygen, forming carbonic oxide or dioxide, as conditions will permit. The injection of superheated steam to all appearances decomposes into oxygen and hydrogen and at the same time agitates the fused electrolyte, thereby increasing the electrical energy.

As an oxygen-bearing compound the natural ores in lieu of the oxygen-bearing compounds previously referred to have been used. If the temperature of the electrolyte be raised sufficiently, the metals from the ores may be reduced at the same time the electrical energy is produced and at one and the same operation. Care should be taken that the ore does not choke or clog the electrolyte or that the reduced metal will not short circuit the carbon anode with the pot. In this double continuous operation the metal is tapped from the electrolyte at intervals. The superheated injected steam is here continuously introduced after the electrolyte is fused. Of course this is only applicable to such ores as are easily reduced.

In using a hydrate or nitrate of an alkali for a fused bath, electrolyte, or conveyer in which the oxygen-bearing salt is the oxychloride or subchloride of copper, the electrolyte-containing pot should be of copper, because better results are obtained electrically, especially in electromotive force—that is to say, a higher voltage is obtained.

In using the metallic oxides or oxygen-bearing compounds it has been noticed that if enough surface is given by the electrolyte, bath, or conveyer which contains the above named metallic oxides or oxygen-bearing compounds to the air large quantities of oxygen seem to be absorbed from the surrounding atmosphere. This is especially noticeable if copper oxychloride, or subchloride, or barium oxide, or barium hydrate is used. The last named chemical is on heating transformed into the oxide.

The bath electrolyte or conveyer in this case can be preferably an alkaline hydrate or nitrate. A water heating chamber is placed within the furnace and a pipe is led from it into the electrolytic cell, by means of which the furnace is made to generate the superheated steam and force it into the electrolyte.

Whittemore's Coal Solution for Primary Batteries.

THE combinations and mixtures of solutions tried for primary batteries are endless, and new ones are still constantly suggested and applied. The most recent is that of Mr. J. B. Whittemore, of London, who in a recent patent describes the application to primary battery solutions of ordinary coal prepared in a special manner and mixed with water. He also discovered that the specially treated coal has another remarkable property, and that is that when added in a small quantity to the acid solution of an ordinary battery cell it increases the quantity and strength of the current therefrom in such a manner that iron may be used in place of zinc as the positive element in the cell. The cost of treating the coal is insignificant, and as the coal is itself inexpensive, Mr. Whittemore claims that considerable economy will be effected in an ordinary battery by using ordinary water as the liquid of the cell in place of an acid solution and by adding thereto coal which has been treated in the manner described below.

The hard or soft coal is treated in the following manner: A block of convenient shape and size and, say, of about four or five pounds weight is taken, and on the top of this is placed a small piece—say of about ten grains weight—of sulphur, camphor, pitch or of any other inflammable substance which when burned in the open will ignite, and allow it to burn itself out on the top surface of the coal. When the inflammable substance has burned away the block of coal is at once adaptable for use in a water liquid cell or as a means for augmenting the electrical properties of an acid solution cell.

Mr. Whittemore has made and tested three double fluid cells, each having carbon and iron elements, the liquids being water drawn from the ordinary domestic service pipes, to which has been added coal treated in the manner above described. For the first of these cells the coal had been perpared by burning a small piece of sulphur thereon, for the second camphor had been used instead of sulphur, and for the third pitch had been used instead of sulphur or camphor. The coal is preferably added to the cell containing the carbon electrode; but it may be added to both. Each of these cells when kept at a temperature of about 60 degrees Fahrenheit gave, when tested, a current of one volt and 0.5 ampere. The current of the cells is observed to vary. As

much as one ampere at one volt has been obtained. One-half ampere at one volt has been frequently observed, but often no more than one-quarter ampere at three-quarters volt and sometimes less, depending, perhaps, upon the temperature or on the atmospheric influences. The current has been observed to continue in diminishing volume for weeks.

From these results it would seem that the burning of a small quantity of an inflammable substance on coal effects a change of some kind in the molecular structure of the coal, rendering it after such treatment advantageous for use in an electrical battery; but whatever the theoretical effect on the coal may be it is certain that an electrical current of appreciable quantity and strength is produced by the use in a water liquid cell of the coal treated in the manner before described and that no such result is produced when ordinary coal not so treated is added to the water liquid cell. Mr. Whittemore has also tried the effect of the addition of the specially treated coal to an acid solution cell. For this purpose he took an ordinary Bunsen cell of three pint capacity, and to this added about six ounces weight of the specially prepared coal in small pieces to the nitric acid solution, and substituted an iron element for the zinc. When tested, this cell gave substantially the same voltage and ampere measurements as the original Bunsen cell from which it was made.

Questionable Economy of Changing Primary Pressure.

BY BINGHAM HOOD.

WITHIN the past few years there have been a number of stations that have, in order to reduce the line losses, due to increased load that has not been provided for in original construction, changed their primary pressures from 1,000 to 2,000 volts.

Some have taken this step by the advice of competent engineers or through managers, but a large number simply because some similar plant has effected a large saving by the change. Fortunately a large number of this latter class have been able to decrease their running expenses by making the change, but a considerable number have found that, after expending a considerable amount of capital, the saving does not begin to cover the interest on the investment.

There are two questions that will be asked any one suggesting such a change. First, what alterations are necessary, and what will it cost to make them? Second, how much can be saved by making the changes?

Whether the answer to the first question is greater or less than the second, will determine the advisability of making the necessary money outlay. Taking up the first question the necessary changes would be: All converters must be rewound for the higher pressure, or, more practically, replaced by new ones; all switchboard instruments depending on the potential for their operation, must be either altered or new ones substituted, and dynamo armatures must be rewound for increased potential, and, if of compound field type, the field shunts or series converters must be changed in order to keep the compounding factor the same.

Presuming that an accurate record of all converters has been kept, with their respective capacities, the determination of the cost of material is comparatively simple. To this must be added the cost of labor to make the changes. The old converters, unless of very recent type, will be of very little value; probably about sufficient to cover the labor cost of removing them and substituting the new ones. It is well to consider while making a change of this kind, whether or not it is advisable to put in new two-phase machines, and reduce the number of periods of alternation, with a view of obtaining a power load. In small stations, however, it is seldom advisable to attempt running a day service unless the conditions are unusually favorable to obtaining a considerable number of motor customers.

Taking up the second and more complicated question, the first step would be to determine the number of kilowatts expended in the line per year. Some stations keep an accurate record of this amount, but by far the greater number do not. If no record is available, it would be necessary to determine an average by taking the switchboard readings for a few days or weeks, and then approximating this amount for the year.

A very simple way of doing this is to take half-hourly readings of each amperemeter, and the difference of pressure between the switchboard and centers of distribution. If such center is connected by a pressure wire it is only necessary to take readings from the two voltmeters on the board, one connected to pressure wire and the other directly across bus-bars.

If there is no pressure wire, the second voltmeter will necessarily have to be connected directly at the distribution center; readings being taken at pre-determined intervals by an attendant at this point. Just here a word of warning will not be amiss. Do not assume that the voltmeter readings are the true pressures; the readings must be multiplied by the ratio of convertion of the transformer to which they are connected.

After having obtained these readings for a time sufficient to give a fair average record of the load (one full week would probably be sufficient), the product of the amperes and voltage difference of the two points will give the watts expended in the line. It is now necessary to determine the cost of furnishing this amount of power. The running expenses will remain practically the same, with the exception of fuel, and possibly water, if same is purchased by meter. Unless an accurate record of this amount, per unit at switchboard, has been taken, it will be necessary to determine the cost at the same time previous readings were taken. After obtaining this cost per unit, the number of units expended in line must be multiplied by it.

From the well known law we find that if we double the pressure, the same amount of energy can be transmitted with one-fourth the line loss. Therefore, by raising the pressure from 1,000 to 2,000 volts, three-fourths of the energy previously wasted in the line will be saved, thus giving the answer to second question.

Comparison between the result thus obtained and the interest on the cost of making the change will determine at a glance whether it will result in profit or loss. The cost of making the change will be very nearly the same for any two stations of the same size, but the saving may vary greatly; depending entirely on local conditions. For instance, one may have a fairly constant load factor, while the other may have one varying from full load for a few hours to nearly no load for the rest of the running day. Again, one may pay a high price for fuel, while another may obtain it for nearly the cost of mining; or may use water power, in which case the saving would be practically nothing. It is therefore evident that each station must examine the conditions governing its own particular case, and not use data obtained from any other plant, as the saving is directly affected by either of the above stated conditions.

In some cases the line loss can be reduced to the same extent by a judicious application of feeders, with booster converters or regulators at their switchboard end, at a cost not exceeding that necessary to change the system to a higher voltage, thereby saving much of the confusion and inconvenient interruptions of service, unavoidable where a general change of apparatus is carried out.

Acetylene Gas Lamp Factory For Niagara.

A new factory now being built on the property of the Niagara Falls Power Company, at Niagara Falls, is to be used for the manufacture of portable lamps, in which the fuel will be acetylene gas generated from carbide stored in cartridge form in the lamp. When the lamp needs "refilling" all that will be required will be to take out the old cartridge and insert a fresh one. The carbide for charging these cartridges is to be obtained of the Acetylene Light, Heat and Power Company, whose plant is situated close by the new factory, so that there will be no expense of transporting it from one plant to the other. The factory building will be of frame, two stories high and 50 by 110 feet at the foundation. It is being erected by the Electro Gas Company, of New York, for another body of men who will put the experiments and theories of the first-mentioned company into practical use. It is understood that experiments extending over a period of several months have been made in burning acetylene in all styles of lamps, from those used for household purposes to the bicycle and carriage lamp, as well as lanterns, and that the experiments have been so successful that the company are eager to get their plant in working order in order that they may get their wares on the market in great quantities. Gas is well known as a very clean illuminant, but in many cases the owners of buildings have been deterred from using acetylene by the fact that they would have to pipe their houses the same as though they were about to use coal gas. With the use of the portable gas lamp this expense will be saved, and if as successful as predicted, the lamps may come into quite general use.

New Type F Wagner Transformers For Lighting Work.

THE new types of transformers recently placed on the market by the Wagner Electric Manufacturing Company, of St. Louis, are the results of many years of labor in experimenting with transformers and in gaining experience in transformer design. The new transformer illustrated and described below is called the type F transformer and differs from their well known type G only in that it has a slightly lower efficiency. It is intended for night service stations and is specially constructed and recommended for this class of work. Both types of transformers are designed to afford a degree of economy in transformer service in excess of that heretofore possible with transformers built by this or any other company. It furthermore embodies many decided mechanical improvements.

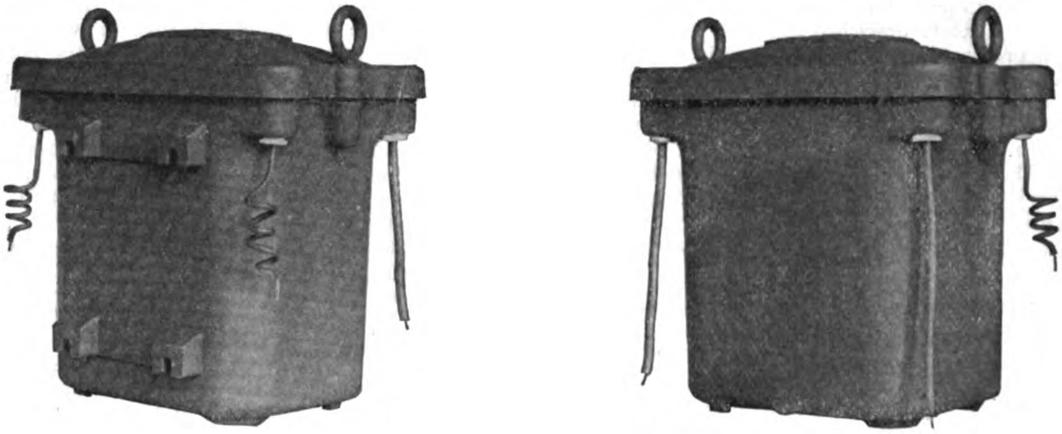


FIG. 1.—WAGNER TYPE F TRANSFORMER WITHOUT FUSE CUT-OUTS.

The general design is clearly shown in the illustrations, but the following special features are worthy of mention: First, the leads, both primary and secondary, are brought out vertically through most substantial porcelain bushings, and are of extra flexible standard cable. The cable used is of the very best high tension quality, and its flexibility greatly facilitates connection to line wire when erecting. The general character of bringing out the leads is such that surface creepage of current to the case is an impossibility. Second, the covers to the cast-iron cases are held down by the eye bolts in place of small screws as heretofore, and a broad lip comes down over the top of the box, assuring the effectual draining off of all water, whatever the atmospheric conditions. Third, the hanger irons are no longer bolted to the cases, but now slip into receptacles cast upon the boxes (see Fig. 3) greatly facilitating erection, from the fact that the lineman requires no tools whatever in the operation. The sizes of hanger irons have furthermore been decreased greatly in number, one size of iron fitting four or five sizes of transformers, where heretofore each size of transformer has required its special size of hanger iron. No improvement in any direction will be more appreciated than this of simplifying the work of erection. Fourth, there are but two secondary leads, instead of four, the connections for 50 or 100 volts being now made on an interchangeable block inside the case instead of by cross connections on the outside, with the single exception of the 500 watt size. In this size the standard is wound invariably for 100 volts, although both 50 and 100 volt ends will be provided where especially ordered. Fifth, two types, one with and the other without attached fuse blocks, are built. The attached fuse block is that form built in independent box form. The fuse is carried in a completely closed tube within a removable porcelain plug. This construction is shown quite well by Fig. 4.

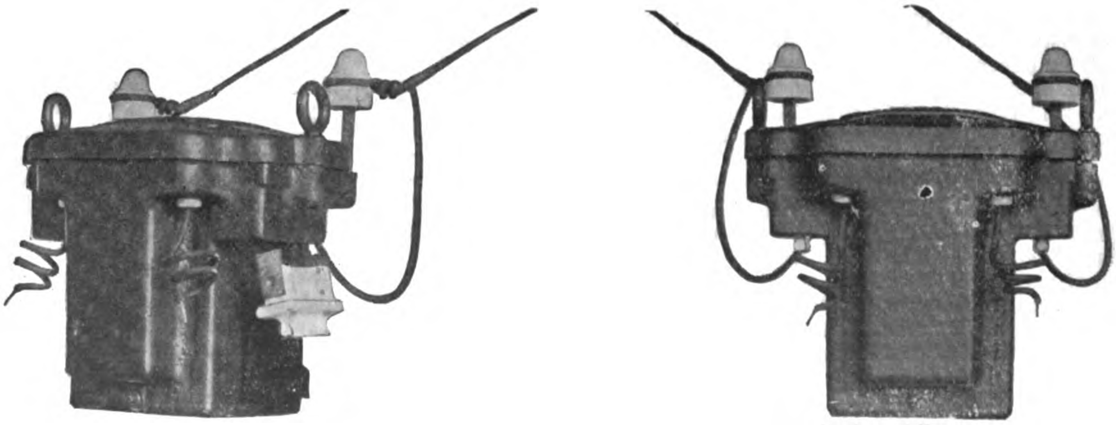


FIG. 2.—WAGNER TYPE F TRANSFORMER WITH ATTACHED FUSE BOXES.

The principal features of the interior construction of the transformer are: First, the coils are placed horizontally so as to increase the safety of the windings. Second, all ends come out without crossing. Third, the transformer proper slips into the case in a new way which provides against mechanical displacement. Fourth, all 2,000 volt transformers, with the exception of the 500 watt size, are provided with an interchangeable device enabling the connections to be easily changed for operation on either 1,000 or 2,000 volts as desired. This same interchangeable principle is employed upon the secondaries, enabling them to be run on either 50 or 100 volts. Small copper links serve the purpose of completing the connections of the transformer coils to the outside leads. Simple changes in position of these permit the change of voltage. Fifth, the type has been designed for use dry or oil filled. Transformers for 1,000 volts may be used in either manner, at the selection of the purchaser. For all 2,000 or higher voltage coils, oil is recommended. No mechanical changes in the cases are necessary to adapt them to either dry or oil service. They are ready for use in either manner when shipped from the factory. The plug seen on the front side of the case, near the bottom, serves merely for the draining out of the oil when it is desired to shift a transformer from one place to another. This opening also remains closed when the transformer is used dry.

Special attention has been paid to the insulation of the transformers, and no better evidence of the thoroughness of the insulation of the windings could be given than in the following specification for testing, which every transformer built must meet:

	Alternating voltage required to withstand Dry.	Oil-filled.
Insulation between primary and secondary..	6,000	10,000
" " primary and case........	6,000	10,000
" " secondary and case......	6,000	10,000

Furthermore, every transformer is guaranteed to safely withstand, as an insulation test, the application to the primary of twice the voltage upon which it is to operate. In other words, 4,000 volts may safely be sent into every 2,000 volt transformer, and no harm will result. Such tests preclude the possibility of a defective transformer leaving the factory.

The exclusion of the air from the windings, the assistance afforded in cooling and the very high insulating value of properly selected oil are its especially valuable qualities. Safeguards in the use of oil are quite essential, however, and for this reason the guarantee on Type F transformers only holds good when oil is furnished by this company. The practice is rigidly followed in the Wagner Co.'s factory of treating and testing by a special process all oil used for transformer purposes. This practice insures a quality of oil that can be depended on, whereas were they to permit the purchase of oil by the customer in the open market there would be no way of knowing anything about the quality of the oil he might secure.

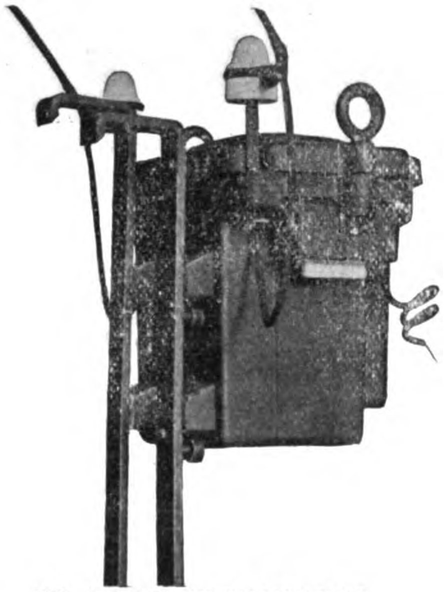


FIG. 3.—METHOD OF HANGING.

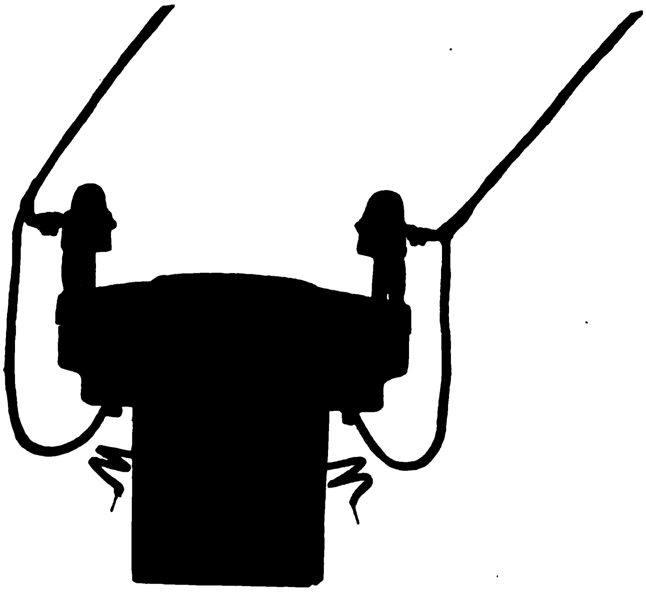


FIG. 4.—FUSE BLOCK WITHDRAWN.

Much has been said of late relative to the "ageing" of the iron in transformers. This phenomenon has been under investigation by the company for several years, conducting many series of tests through that interval to determine the extent of the ageing going on in their transformers. These tests have demonstrated that the ageing taking place in the Wagner apparatus is an almost inappreciable one, guarded against as it is by a most thorough maintenance of those special properties of the material which minimize the effect.

While no good station superintendent makes it a general practice to overload his transformers, nevertheless occasionally circumstances arise making it inevitable to load a specific transformer beyond its rated capacity for a limited period. The Type F transformers can be safely overloaded 25 per cent. for a period of three hours, without incurring damage to the insulation. In some instances, engineers who do not desire to depend on the very high insulation between primary and secondary windings, specify the insertion of a metallic shield for the secondary coils. This shield is grounded to earth, and in case of any puncture of the insulation of the primary winding, all leakage current escapes directly to earth instead of to the secondary coils should their insulation also give way. Where such extra precaution is required, the Type F will be so constructed, the general design adapting itself excellently to this end. Such ground plates are not, however, recommended where their use can be avoided.

Mr. Wagner has always advocated the close testing of all transformers. Every central station should have a record of the performance of its transformers. Such a record can be easily maintained, as the essential tests to be made are such as adapt themselves readily to station conditions and equipments. The instruments required for these tests are those frequently used on other kinds of testing about lighting and power plants, and the time required is relatively small. The most important test is the measurement of the "core" loss, or "leakage" loss. This is the loss constantly going on in the transformer, whether the customer be using current from the secondary mains or not. Next in importance is the "regulation" test. These two tests at once disclose the electrical characteristics of the transformer, and will enable the station man to determine for himself the relative excellence of various makes of transformers offered him. Finally he should test the insulation of each transformer on its receipt from the factory. The instruments required for the core loss test are an indicating wattmeter and a voltmeter. The Wagner Co.'s Type H instruments are admirably adapted to this purpose. For core loss measurements a wattmeter reading up to 300 watts is recommended. For the voltage measurement a voltmeter with scale of from 90 to 120 volts. The method of test is to send into the secondary the rated secondary pressure, leaving the primary ends open. The source of current is usually the ordinary station lighting circuit, providing this is supplied from the generator on which the transformers are to operate or from another machine which generates the same frequency of current. By means of an adjustable rheostat the pressure at the terminals of the transformer under test is brought to exactly the rated amount. The wattmeter will, when connected in circuit according to instructions that are furnished with it, indicate the watts lost. It must be understood that the core loss on any two transformers of the same size is not necessarily the same, and that the results shown by any given transformers are not necessarily indicative of results to be expected from that make in general. Every transformer should be tested for core loss. The regulation test is not so easily made. However, it is not necessary to make it upon every transformer. It is only recommended when the station superintendent desires to compare one make of transformers with another. The three things to be determined are: 1st—The ohmic resistances of the transformer windings. 2d—The voltage necessary to send the full load current through the transformer when the secondary is short circuited. 3d—The "leakage" current in amperes. The ohmic measurements should be made with the Wheatstone bridge or with direct current instruments, employing direct current instruments in preference to the bridge on account of the low resistance of the secondary windings of transformers. The second factor, commonly called "impedence" voltage, calls for an ampere meter in addition to the voltmeter and wattmeter. An instrument reading up to 10 amperes is recommended. The Type H ammeter will serve nicely for this purpose. The third factor can be determined by

dividing the core loss in watts by the factor 65. This is not strictly accurate, but is a sufficiently close approximation for general work.

The Wagner Co. have also placed on the market within the last few months large astatic transformers for high voltage power transmission. They are prepared to construct the apparatus in units of any size required, and for any ratio of voltage transformation desired. Many of these large transformers have already been installed in Western power plants and are giving excellent service.

Temperature Coefficient of Resistivity of Graphite.

BY JOSEPH W. HARRIS.

IN February, 1897, Mr. J. W. Howell read a paper before the American Institute of Electrical Engineers on "The Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them," in which he gave a curve showing change of temperature coefficient of resistivity of graphite from negative to positive. I wish to call attention to the fact that the temperature at which this change takes place in graphite is not very different from the temperature of recalescence in a high carbon steel, and think that the change in graphite must also be accompanied by a change in its chemical properties, on account of the corresponding change in the properties of steel when suddenly cooled from temperatures above or below the temperature of recalescence.

TELEPHONY AND TELEGRAPHY

The New Electrical Factory of DeVeau & Co.

THE rapid development of telephony in this country and the construction of numerous "independent" exchanges has naturally opened up a large and remunerate field for the manufacture of telephone apparatus and appliances. The older concerns, whose apparatus has been used for years and has been

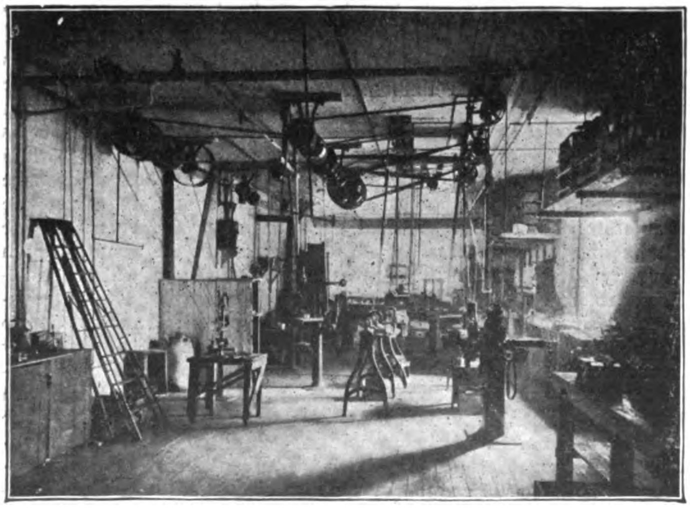


FIG. 1.—NEW MACHINE SHOP OF DE VEAU & CO.

thoroughly tested and constantly improved, are finding a more extended market for their goods and are forced to seek larger quarters. One of the best known manufacturing concerns of telephone and other electrical supplies in the country, De Veau & Company, found their factory inadequate for filling the orders which were constantly increasing in number and size due to the above conditions and have lately moved into very commodious quarters at 27 Rose street, New York City. The factory covering an area of 135 by 250 feet consists of a spacious and well-equipped machine shop, shown in Fig. 1. It contains numerous planers, engine lathes, automatic machines, millers and drill presses. Then there is the assembling room, shown in Fig. 2, where the transmitters, receivers, magnetos, etc., are assembled and tested, the superintendent's desk being shown in the foreground; the inspection department, where every telephone set is thoroughly tested before it is shipped from the factory; the forging depart-

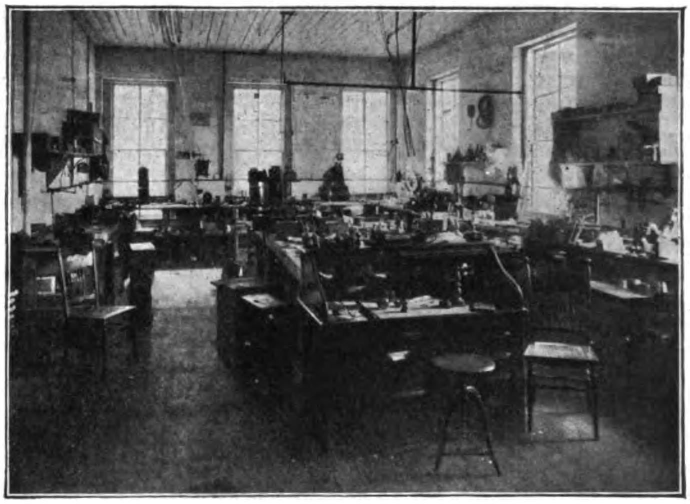


FIG. 2.—ASSEMBLING ROOM IN DE VEAU & CO.'S NEW FACTORY.

ment, where the magnets for the magneto-generators are shaped; the shipping department and the business offices of the executive officers of the company. Over fifty hands are employed in the establishment, which number will probably be increased at an early date.

The goods manufactured by this company, which have frequently been illustrated in The Electrical Engineer, are of the best quality and every small feature receives the most careful attention. Tests are made continually to see whether some detail cannot be improved or whether a change of material will not produce better results. The De Veau transmitter is guaranteed not to pack, nor to get out of adjustment. The packing is prevented by stretching a piece of oiled silk between the mouthpiece and the small contact point, to keep out the moisture. The diaphragm is pressed against the shell by a couple of large flat springs bearing against it in four places. A small canvas receptacle filled with powdered carbon is supported on a delicate spiral spring which serves for the final adjustment of the instrument. This also prevents sticking and is a novel feature in this transmitter. All parts are interchangeable and the best material is used throughout. The coils are silk covered, the magnets in the receivers are shellaced and the binding posts possess admirable features. The magneto-generators have a clear ring. The crank has to be pushed inward before a signal can be given. This enables special calls to be transmitted between private subscribers, which is often a great convenience. The magnetos have specially long switches insuring good contacts and the woodwork on all the apparatus is of very high quality.

The company manufacture long distance telephones, combination sets, intercommunicating telephones, desk and interior telephones, special hand telephones, transmitters, receivers, magnetos, switchboards and telephone supplies of every conceivable variety.

The apparatus of the company has been installed in U. S. Government offices and by numerous large corporations as well as many well known business houses in this city and throughout the country, and export orders are constantly being filled.

The company was formed in 1892, by Mr. A. S. De Veau, and to his indefatigable energy and extensive experience the success of the firm is mainly due. Mr. De Veau was employed by the Western Electric Company and other telephone concerns for over ten years in every conceivable capacity from mechanic in the shop to line constructor and operator, and has mastered the business in every detail. The superintendent of the factory is

Mr. Charles Auth, who has had a long experience in the construction of telephone apparatus.

The company have never had an infringement suit or any legal interference and have won by the merits of their apparatus the confidence of the profession and the general public.

The Budapest Talking Newspaper.

A SMALL diamond-shaped board screwed on to the wall of my room, and provided with a couple of hooks from which hang two tiny, round telephone earpieces connected by two wires. That is all. But my hotel proprietor has been singing its praises for the last twenty minutes, and as he confidentially assured me that it will not play any part in my hotel bill at the end of my stay, there is no earthly reason why I should enter any protest against his profuse encomiums. "This," said he, "is the Telephonic Messenger or talking newspaper—the only thing of its kind in the world. It has now been established in Budapest about three years. It differs from the ordinary telephone in the fact that the latter is directly connected with the central office, whereas we are able to connect from 200 or 300 subscribers in one circuit. The city is divided into thirty circuits. All day long news is spoken into a specially constructed apparatus at the central office, varied with entertainments, the opera and linguistic lessons. It is not a telephone in the strict sense of the word, and therefore, does not infringe the telephonic rights of the government. It combines the functions of your tape machines and electrophones, while it is ten times cheaper. That buzz you heard just now was to prevent subscribers talking to each other on their own account."

"It seems strange that such an excellent idea as this appears to be should not be introduced in other towns than Budapest," I ventured.

"The answer is very simple. Of course, the newspaper feature would be impossible in London, where time is everything, and a man could not sit the whole day with the apparatus to his ear, waiting for some particular news or exchange prices. Then again, other towns are not so advantageously situated in this respect as Budapest, where the law empowers the company to introduce the apparatus into any house in the city in spite of the objections of the landlord. We have here six thousand subscribers, and each pays only eighteen florins a year. With us it is as in England with a certain soap—our families don't feel happy until they get it. It is so cheap that many of the rooms in my hotel are fitted up with it. If the visitor finds it inconvenient to go to the opera, all he has to do is to put this apparatus to his ear, and he can be entertained the whole evening. The general public, too, can have news in advance of the newspapers. Why, a few weeks ago, when the German Kaiser gave that celebrated toast of his to the Hungarian nation, thousands of families were listening to its recital half an hour later. Without this apparatus they would have had to wait until next day."

"Have you a regular daily programme?"

"Yes, it is announced in the morning, and changes every half hour or so. The greater part of the morning is taken up with prices on 'change, a summary of the news in the dailies. At noon we begin to get a report of the doings in Parliament. Telegrams of importance are communicated at once, the Telephonic Messenger being in direct connection with a leading Budapest newspaper. At about 2 o'clock the morning news is in part repeated, then come exchange prices, telegrams, law reports, a short, entertaining story, theatrical items, and sometimes a concert, and for an hour in the evening we get a lesson in English, Italian and French. You have no idea what a benefit this is to the young generation, and how popular these lessons are among them. A complete set of graduated exercises has been published in these languages. Each telephone subscriber who cares to listen holds a copy of the book in question before him, and the teacher speaks into the double microphone transmitter at the central office."—Pall Mall Gazette.

THE UNION TELEPHONE COMPANY has been organized at Portland, Me., for the purpose of acquiring and operating telephone lines and dealing in telephone and electrical supplies. The papers of incorporation call for a $10,000,000 capital stock, of which $300,000 is paid in. The officers are: President, Frederick H. Gorman, of New York City; treasurer, George A. Beaton, of Detroit, Mich.

Fifteenth Annual Report of the Erie Telegraph and Telephone Co.

THE fifteenth annual report of the Erie Telegraph and Telephone Company will show as follows: The principal assets consist of sixty-five per cent. of the $2,000,000 capital stock of the Cleveland Telephone Company, seventy per cent. of the $2,400,000 stock of the Northwestern Telephone Exchange Company, seventy per cent. of the $4,000,000 stock of the Southwestern Telegraph and Telephone Company. These companies operate under American Bell license in Cuyahoga County, O.; in North and South Dakota and Minnesota, except the Black Hills district and the city of Duluth, and in the States of Arkansas and Texas. These three sub-companies show consolidated income and expense accounts as follows for the year ended December 31:

	1897.	1896.	Increase.
Income	$1,412,023	$1,206,147	$205,876
Expenses	871,167	706,135	165,032
Net earnings	$540,856	$500,013	$40,843
Surplus account Dec. 31, previous year	203,806	165,456	38,350
	$744,662	$665,469	$79,193
Dividends	532,000	461,663	70,337
Surplus account Dec. 31	$212,662	$203,806	$8,856

The income and expense account of the Erie Company shows:

	1897.	1896.	Increase.
Income, dividends	$364,550	$314,914	$49,636
Int. and exec. ex.	137,903	106,274	31,629
Net income	$226,647	$208,640	$18,007
Dividends paid, 4 per cent.	192,000	192,000	......
Year's surplus	$34,647	$16,640	$18,007
Surplus from previous year	198,646	182,006	16,640
Total surplus, Dec. 31	$233,293	$198,646	$34,647
Proportion of sub-company's surplus due Erie Co.	146,155	140,164	5,991
Total surplus	$379,448	$338,810	$40,638

Assets and liabilities of the Erie Company, December 31, 1897, were:

Assets—		
Stocks and bonds		$8,507,266.93
Accounts receivable		131,712.29
Cash		119,182.72
		$8,758,161.94
Liabilities—		
Capital stock (issued)	$4,800,000.00	
Bonds and notes	3,630,500.00	
Reserve	94,369.08	
Surplus	233,292.86	
		$8,758.161.94

The report says that the quarterly earnings for the year 1898 may be estimated safely to be at least equal to the last quarter of 1897. Upon this basis the net earnings in 1898 will increase $110,000. Of this amount the Erie Company will receive about $70,000. During 1897 the number of subscribers increased by 3,198 and total number connected December 31 was 24,587, of which 5,421 were at Cleveland, 7,196 in the Northwest and 11,970 in the Southwest; total exchanges in operation, 65; total number of cities and towns connected, 510; expended on plant and equipment during the year, $1,591,305.72, of which $1,171,521.31 was for new construction, $231,284.41 was for maintenance, and $188,500 was for real estate. From 1883 to 1897 inclusive, number of subscribers has increased by 18,596; in that period, a total of $6,436,756.68 has been spent on the plant exclusive of original cost; fifty-seven dividends have been paid by the Erie since organization. The sub-companies own land and buildings valued at $578,500. They have 15,630 miles of wire underground, an increase of 3,822 miles in 1897. Wire mileage has increased 13,819 in the year and the total in operation is 55,851 miles. Estimated construction and real estate expenditures for 1898 are $1,000,000 As funds are needed for growth of the business the capital stock

of the sub-companies is increased from time to time, the Bell and the Erie taking their proportions at par, pro rata. The Erie has a five per cent. bond issue, $4,000,000 authorized, to provide funds for taking its proportion of sub-companies' new stock, all of which bonds have been sold, deliverable as the company needs the funds; $2,000,000 have been delivered, making total outstanding indebtedness of the Erie $3,630,500; the sub-companies have no outstanding debt. Earnings of the long distance service increased thirty-six per cent. for the year.

A Swiss Telephone Joke.

A telephone story from Switzerland: A well-known cattle dealer in Berne telephoned to the slaughter house there that he had sent a goodly number of calves thither. At the central station an error was made in the word, as, instead of "Schlachthaus," the word "Rathhaus" (City Hall) was used, and the telephone was placed in communication with that institution, just previous to an important debate. Herr Weibel Häubi, responding to the telephone signal, had his usual serenity ruffled by the inquiry, "Have all the calves arrived yet?"

Government and Private Telegraphs in Mexico.

Consul General Donnelly, writing from Laredo, Mexico, says: "An interesting phase of government ownership of public utilities is being presented in Mexico, where the Government operates a telegraph line of its own in competition with the lines of the several railroads. Advocates of government ownership would doubtless expect the government service to be the cheapest and best. Such, however, is not the case. The railroads give the promptest service and generally at lower rates. The following table shows the government and railroad telegraph rates on ten words from Nuevo Laredo to the cities named:

Nuevo Laredo to—	Government rate.	Railroad rate.
Monterey	$0.40	$0.26
Saltillo	.60	.51
San Luis Potosi	1.20	1.16
Mexico City	1.60	1.61

"As a natural consequence, the railroads have done the great bulk of telegraph business, both foreign and domestic."

NEWS AND NOTES

The Omaha Exposition.

The illumination of the grounds and buildings of the great exposition, for which Omaha is now preparing, will be made on a scale of magnificence unexcelled even by the wonderful effects obtained at Chicago in 1893. Mr. Luther Stieringer, the lighting expert of the World's Fair, is consulting electrician for the Omaha Exposition Company. Not less than 2,155 kilowatts in dynamos and transformers have already been ordered from the General Electric Company, for purely illuminating purposes. In detail, the contract covers four 125 2,000 candle power Brush arc dynamos, of the multi-circuit type; four 120 kilowatt and two 180 kilowatt alternating current, high periodicity dynamos, operating at 1,040 volts, together with 840 kilowatts in type H transformers of different sizes. Current for various power purposes will be supplied from a generator of 225 kilowatt capacity operating at from 500 to 550 volts.

The arc lamps will number 600, of 2,000 candle power each. These are to be of either the double or single carbon type at the option of the General Electric Company, but, if the latter are used, they are to be arranged for fourteen hour service. The contract also calls for the necessary exciters and all the switchboard appliances for the operation of the above machines.

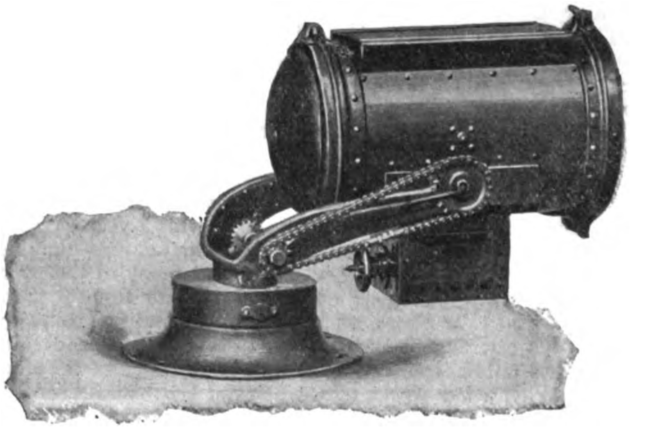
NORRISTOWN, PA.—Falkenau Electric Company, of Philadelphia, have a contract for a city plant to be furnished at a cost of $41,191.

ELECTRIC LIGHTING

New Rushmore Marine Projector.

We illustrate herewith a new type high power lens mirror projector lately brought out by the Rushmore Dynamo Works, of Jersey City, N. J., who, as is well known, make a specialty of marine equipment. This little light is intended for the smaller class of yachts of 100 feet or under, and is not too large for the smallest boat that can float a dynamo to supply the current. The lens is 9 inches in diameter and the total height 15 inches and weight 40 pounds. It throws a clear round solid beam, and with 8 amperes will show up a buoy about one-half mile away on a dark night. The first projector of this type was installed on the racing yacht "Presto," built by Mr. Chas. D. Mosher for Mr. Wm. Mollenhauer. The beam is controlled by two distant controllers, one in the pilot house and the other aft on the bridge.

The Rushmore works are building projectors in all sizes up to 72 inches diameter for all classes of naval and commercial service. They have cut free from the foreign lens makers and now claim to have the finest lens-making plant in the country. They not only grind and polish the lenses, but prepare the special glass required and have lately installed a large sweating furnace heated with crude oil vaporized by heated compressed air. Selected pieces of the prepared glass are placed in fire clay moulds of the shape of the rough lens, and the heat is gradually increased until the glass "sweats" down between the halves



RUSHMORE LOW BASE MARINE PROJECTOR.

of the mould and the surplus oozes out from the sides. As soon as the "sweating" is completed, the mould is placed in an oven and buried in red hot sand and the temperature is gradually reduced over a period of two weeks. The glass when cold has become thoroughly annealed and will stand the severe heating and chilling to which it is exposed in the searchlights without risk of breakage.

The grinding is done in large machines which sweep out the true parabolic curve with an accuracy that has heretofore been considered impossible, and were it not for the fact that the crater of the positive carbon from which all the projected light comes is of considerable size, instead of being an infinitesimal point as is the focal point of the lens, the beam would not spread at all, but would appear to an observer near the light to run to a point and disappear. The inevitable spreading due to the crater is in practice just the amount required to equal the parallax and thus to the operator the beam appears perfectly parallel.

The Rushmore works have during the last week sold over fifty projectors for all classes of service. Seven 14-inch projectors are being shipped to San Francisco, and four of the same size to Portland, Ore., for a steamer fitting out for Alaska. They also sold a complete plant consisting of one 6 kilowatt and one 30 kilowatt direct connected generating sets, switchboard and a 45 ampere projector for the Alaska steamer "Cartina," now fitting out at Elizabethport for the Boston-Seattle Company, and on the same day they closed a contract through their Baltimore agents, D. E. Evans & Co., for a 12 kilowatt

generating set and a 25 ampere projector for the steamer "Susquehanna."

Electric Lighting Consolidation in Philadelphia.

Formal announcement was made on Feb. 15 that a controlling interest in the stock of all independent electric light companies of Philadelphia had been acquired by the Pennsylvania Manufacturing Light and Power Company, incorporated under the laws of New Jersey, with a capital of $15,000,000. The announcement is made by Mr. Martin Maloney, president of the Pennsylvania Heat, Light and Power Company, which absorbed the local Edison Company through the medium of a collateral trust two years ago. The new company will issue $15,000,000 collateral 5 per cent. gold bonds in exchange for the stock of the minor companies.

No organization of the new $15,000,000 enterprise has been effected yet, but Mr. Maloney will be made president.

MARRIED

Hayden—House.

We are glad to record the marriage, at Marion, N. C., on February 22, of Mr. Hobart D. Hayden, superintendent of the Suburban Electric Light Company, Scranton, Pa., to Miss Edith E. House, of that city.

SOCIETY & CLUB NOTES

National Electric Light Association.

The next meeting of this association will be held in Chicago, Ill., June 7, 8 and 9 next. The headquarters will be at the Auditorium Hotel. The rates for accommodation at the hotel will be from $3.50 to $5 per day on the American plan, or $2 to $4 on the European plan. The hotel gives the association the use of the banquet hall for the meetings. Announcements of papers to be read will be made later. All communications should be addressed to Geo. F. Porter, Secretary, 136 Liberty street, New York City.

Electrical Engineers of the Twin Cities at Dinner.

THE electrical engineers of the Twin Cities, to the number of thirty-five, sat down to a banquet at the Windsor Hotel, St. Paul, on Washington's Birthday. It was an annual feast of the fraternity, the second of its kind, the first having taken place in Minneapolis last year.

Morgan Brooks, of Minneapolis, presided and officiated as toastmaster. Others from that city were Prof. George D. Shepardson, Charles W. Gilchrist, Adolf Wagner, H. F. M Dahl, William Robertson, C. F. Wyman, George W. Hayford, A. M. Laird, James T. Boustead, W. F. Clarke, C. H. Edwards, P. A. Clisdell, W. W. Dokin, F. W. McKellip, Frank E. Reidhead, Robert D. Valentine, W. J. Chapman, James Reardon, J. S. Webster and C. H. Chalmers.

The city of St. Paul was represented by A. Wilford Zahm, F. D. Varnum, John Gorman, J. H. Whitaker, Joseph King, C. E. N. Howard, J. G. Robertson, S. A. Jones, E. J. Larkin, Robert W. Clark, J. J. Schoenleber and E. L. Hart, of the Edison Company. B. B. Downs, of the Electrical Appliance Company, of Chicago, was also a guest.

It was a quiet, pleasant, sociable feast intended to emphasize the sentiment of good fellowship between the representatives of the profession in the two cities.

Mr. Brooks, as toastmaster, began the speech-making in a cordial address. He was followed by Prof. Geo. D. Shepardson.

Mr. Whitaker, of St. Paul, spoke of "The Uses and Abuses of the Telephone.". P. A. Clisdell responded to the toast of the General Electric Company, and J. S. Webster to that given to the Walker Company. John Gorman made some remarks on "Electric Wiring Ten Years Ago and To-day." Mr. Zahm read several letters of regret received from those who were unable to be present. The evening was enjoyed by those who attended as an incident affording recreation and instruction, and it was decided to give these dinners quarterly instead of annually as heretofore, the next one to occur in Minneapolis.

American Institute of Electrical Engineers.

The 122d meeting of the institute was held at 12 West Thirty-first street Feb. 23 and was called to order by President Crocker at 8.30 p. m. About seventy-five members and guests were present. A paper on the "Single-Phase Induction Motor" was read by Mr. Steinmetz and was discussed by Prof. W. S. Franklin, Dr. A. E. Kennelly, Messrs. E. E. Ries, Townsend Wolcott and others.

At the meeting of the Executive Committee in the afternoon the following associate members were elected: Frank Broili, electrical engineer, California Elec. Works; residence, 823 Geary street, San Francisco, Cal. Samuel Byington Libby, superintendent N. Y. & S. I. Electric Co., West New Brighton, N. Y. Otto T. Louis, manager of New York Branch, Queen & Co. Inc.; residence, 340 East 119th street, New York City. James A. Mortland, professor of physics, Faculty State Normal School, 2502 Walnut street, Cedar Falls, Iowa. Chas. H. Schum, electrical engineer, Ideal Electric Corp., 216 Third avenue, New York City. C. E. Sedgwick, agent at San Francisco office, General Electric Co., 15 First street; residence, Berkeley, Cal.

Mr. William Goltz, of Milwaukee, was transferred to full membership.

LEGAL NOTES

Decision on Electric Heaters.—The McElroy Patent Sustained.

The U. S. Circuit Court of Appeals for the First Circuit, at Boston on Feb. 18 rendered a decision sustaining in full both claims of the McElroy patent entitled Electrical Heater, No. 500,288, June 27, 1893. The claims of this patent read as follows:

1. In an electrical heater, a wire wound in the form of a spiral spring extending in a spiral path about a cylindrically formed non-conductor, in such a manner that each spiral shall come into contact with the non-conductor at one point only and the layers of spirals shall be separated from each other, substantially as described and for the purpose set forth.

2. In an electrical heater, the combination of an insulating substance, a wire coiled in the form of a spiral spring extending in a spiral path about said insulating substance, a non-conducting material placed between the adjacent layers of the said spring, substantially as described and for the purpose set forth.

This suit was brought originally against the West End Street Railway Company, of Boston, and defended by the American Electric Heating Corporation, the manufacturers of the car heaters used by the West End Company. On Aug. 27, 1897, Judge Putnam, of the U. S. Circuit Court, rendered a decision holding the heaters to be an infringement on the second claim of the McElroy patent, which he sustained, but denying the validity of the first claim on the ground of its identity with the second. Both sides appealed the case, which has now resulted in the U. S. Circuit Court of Appeals fully sustaining both claims.

The American Electric Heating Corporation inform us that this decision applies to car heaters furnished by them to the West End Street Railway Company some years ago, which were a close copy of those made by the Consolidated Car Heating Company, the American Company at that time believing that the patent in question was not valid. They also inform us that this suit has no bearing whatever on any of the present product of the American Electric Heating Corporation and has no reference whatever to the car heaters which they have been selling for the past three years.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued February 22, 1898.

Alarms and Signals:—

FIRE ALARM BOX. J. H. Hayes, Appleton and C. Fisher, Chicago, Ill., 599,654. Filed January 21, 1897. Comprises an electrical circuit, a switchboard, electrical conductors leading from different contacts of the switchboard, a switch lever pivoted to the board, an arm connected to the switch-lever, and a starting lever for actuating the switch operating arm.

Batteries, Primary:—

ELECTRIC BATTERY. C. P. Shrewsbury, London, and J. L. Dobell, Modbury, Eng., 599,405. Filed December 24, 1895. Consists of a metallic cell containing an electrolyte, a chamber therein, a pipe leading from the chamber into the electrolyte and suitable means for keeping the electrolyte in a fused state.

ELECTRICAL PRIMARY BATTERY. Joseph Bruce Whittemore, London, Eng., 599,411. Filed September 8, 1896. See description on page 240.

Batteries, Secondary:—

SECONDARY BATTERY. W. A. Crowdus, Chicago, Ill., 599,315. Filed January 25, 1897. Process of forming negative elements in secondary batteries, consisting in immersing plates coated with lead oxide in a solution of sulphate of an easily-oxidizable metal and sulphuric acid, and passing a current to the plates immersed therein.

Conductors, Conduits and Insulators:—

ELECTRIC WIRE HOLDING APPLIANCE. H. A. McCoy, Cambridge, Mass., 599,346. Filed September 30, 1897. Consists of a support carrying parallel fingers pivoted to each other, having means for holding a line-wire, the fingers being held parallel by a spring, and adapted to be depressed by the weight of the line wire and to grip the same.

STRAIN INSULATOR. J. Clegg, New York, 599,493. Filed December 30, 1895. Comprises metallic parts having their abutting faces insulated from each other and connected by an interposed layer of silica vitrified by means of a flux.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. O. B. Skinner and G. M. Bacon, Cleveland, Ohio, 599,480. Filed August 27, 1897. Enclosed arc lamp; details of construction.

SUPPORT FOR INCANDESCENT ELECTRIC LIGHTS. J. Whitaker, Schenectady, N. Y., 599,543. Filed June 19, 1897. Comprises a plurality of separate fractional sections enclosing a spring coil whereby they are held in close contact with each other.

ELECTRIC ARC LAMP. H. J. Sage, Rochester, Pa., 599,635. Filed March 10, 1897. An arc lamp provided with a carbon-socket supported by rods from the base of the lamp and a threaded lower extension; an inclosing casing below the base provided with clips embracing the rods, a globe, and a globe-holder screwed upon the threaded extension.

Measurement:—

DRIVING GEAR FOR ELECTRIC METERS. G. A. Le Fevre, New York, 599,508. Filed April 21, 1897. Comprises a registering device, a motor, and an operative driving connection between the register and motor whereby the register is moved constantly forward without reference to the direction of the motor's rotation.

ELECTRIC IGNITER FOR GAS ENGINES. F. E. Culver, Chicago, Ill., 599,316. Filed February 15, 1897. Combines two relatively movable chambered contacting parts adapted to carry the electric current, and means for supplying the chambers of such parts with fluid.

ELECTRIC IGNITER FOR EXPLOSIVE ENGINES. H. F. Probert, Chicago, Ill., 599,354. Filed April 8, 1897. Details of construction.

Miscellaneous:—

ELECTRIC RESISTANCE CONDUCTOR. H. G. O'Neill, Brookline, Mass., 599,351. Filed January 4, 1897. A resistance conductor for electric heaters, consisting of an oxide compound cast in the form of a rod, having metallic terminal connections attached to each end.

ELECTRIC RESISTANCE CONDUCTOR. H. G. O'Neill, Brookline, and H. B. Gale, Boston, Mass., 599,352. Filed January 4, 1897. Comprises a non-conductive support having a layer of conductive oxide applied to it while in a fused state.

APPARATUS FOR PRODUCING OZONE. M. Otto, Paris, France, 599,455. Filed June 15, 1897. Comprises a casing, electrodes therein, one being movable in relation to the other and adapted to produce and extinguish gradually the discharges at short intervals, means for moving the movable electrode, inlet and outlet openings and electrical connections with a high-tension transformer.

Railways and Appliances:—

ELECTRIC RAILWAY SYSTEM. J. McL. Murphy, Torrington, Conn., 599,344. Filed September 24, 1897. Magnetic switch for surface contact systems.

TROLLEY FOR ELECTRIC RAILWAYS. E. K. Landis, Philadelphia, Pa., 599,393. Filed March 5, 1897. A pivotally mounted guard to retain the pole when the trolley wheel leaves the conductor wire.

ELECTRIC RAILWAY SYSTEM. J. D. Gibbs, Chicago, Ill., 599,604. Filed March 14, 1896. Embodies a supply conductor, a series of contact rails arranged in insulated sections and adapted to be enlivened when forced in contact with the line conductor, the rails overlapping at their ends, and a trolley having two contact-wheels, each provided with a double tread.

Telephones:—

INDIVIDUAL TELEPHONE CALL. T. C. Drake, Malta, Ohio, 599,322. Filed July 31, 1894. For party lines; details of construction.

TELEPHONE SWITCHBOARD APPARATUS. C. F. Dunderdale, Chicago, Ill., 599,553. Filed July 31, 1896. Comprises a hinged lever connected with the subscriber's line and constituting a line-terminal, which lever is capable of vertical and lateral movement, terminals for auxiliary circuits adjacent to the lever and means for holding it out of use.

OBITUARY

Dennis Doren.

Dennis Doren, general superintendent of construction and repair of the Western Union Telegraph Company, died suddenly on February 25 at Norwalk, Ohio. Mr. Doren, who celebrated his sixty-eighth birthday on February 13, was visiting his nephew, Mr. Pitt Curtis, in Norwalk, when death overtook him. He and his wife had just breakfasted and he was about to leave the house to take the train for Washington when he was overcome by an attack of apoplexy. Death was almost instantaneous. Mr. Doren was born on a small farm in the vicinity of Worcester, Ohio, and began telegraphy in 1850. When Superintendent now President Thomas T. Eckert of the Western Union was put in charge of the military telegraph in the Department of the Potomac he appointed Doren superintendent of the construction corps of that army.

Since the war Mr. Doren has acted as superintendent of construction and repairs of the American Telegraph Company, the Western Union Telegraph Company and the Atlantic and Pacific Telegraph Company.

GARDANIER.—We regret to record the death of the wife of Mr. George W. Gardanier, of the electrical engineering staff of the Western Union Telegraph Company, this city.

PERSONAL

MR. T. A. EDISON has begun vigorous litigation against the numerous infringers of his kinetoscope patents.

MR. F. W. HAWLEY. Two receivers have been appointed for the estate of this well known promoter, etc., who has been actively engaged in a large number of enterprises, and is vice-president of the Cataract General Electric Company.

THE STOCK MARKET

The Effect of War Scares.

Wall street was a faithful index last week of the uneasy feeling prevalent throughout the country as to the possibilities of war with Spain, as the result of the Maine disaster. On the whole, the market was wonderfully steady. Uncertainty is always a discouraging feature, and it is likely that prices will advance whatever is finally settled. There is a general and wholesome desire to avoid war, but if it comes, there will be but one result, arrived at swiftly; while the large purchases of all kinds of supplies would meantime greatly stimulate industry. The condition of trade at present is excellent and improving in every respect.

During the week, Western Union sold off from 90¾ down to 86¾ on sales of 47,515 shares. General Electric sagged from 34¾ to 32¼ on 19,420 shares. New York Edison dropped from 133 to 131. American Bell Telephone was weak, and fell from 265 to 251 on sales of 852 shares.

Copper, New York, Feb. 22, was 11.50, an advance of .25 over the preceding week. It bids fair to continue strong. Heavy steel rail is steady at $18.

TRADE NOTES & NOVELTIES

A New Queen Portable Testing Set.

THE convenience and accuracy of a well designed portable Wheatstone's bridge recommend it highly for general resistance measurements. Its chief advantages, outside of the accuracy attainable and its portability, are its extremely wide range of measurement, and its freedom from error. But these advantages are lost unless the instrument is correctly designed in every detail and constructed with the greatest care. A portable Wheatstone's bridge should be compact and complete. It should require no adjustment and have practical immunity from accident or derangement. The range of measurement should be wide and the accuracy as high as will be required in commercial work.

Economy demands that it shall be designed and constructed with due regard to each of the constants, such as sensibility and resistance of the galvanometer, e. m. f., and resistance of the battery, accuracy of adjustment and values of the resistance coils, in order that they may bear such a relation that no

QUEEN-ACME PORTABLE TESTING SET.

one of them shall so influence the result as to unduly diminish the effect, toward securing a high degree of accuracy in the values sought.

Queen & Co., of Philadelphia, have had on the market for several years their Queen Acme portable testing set, designed to meet the above requirements. How well this result has been secured may be judged from the fact that they are supplying them to telephone companies and electric light stations in this country, South America, Canada, Russia and Japan. Their set is in use on all of the vessels of the U. S. Navy, being approved by the Government for that purpose. Recent improvements of such value have been made in the Queen-Acme as to warrant the manufacturers in calling the attention of the electrical public to their added advantages. The illustration shows the instrument in its new form. A most important improvement has been made in the galvanometer whereby the sensibility has been increased sixfold, greatly extending its range of measurement and correspondingly adding to its accuracy. Another improvement has been an alteration in the construction of the galvanometer, so as to enable it to withstand transportation without injury. The galvanometer is of the D'Arsonal type, deadbeat, requiring no adjustment previous to using, and unaffected by external magnetic fields or mechanical vibrations.

As to the range of measurement, the theoretical limits are from 1-1000 of an ohm to 11,110,000 ohms. Practically the range is from 1-100 of an ohm to 5,000,000 ohms. In the case of the lower limit it gives a result accurate to one per cent. When measuring five megohms the accuracy is two per cent. For intermediate values the accuracy is much higher, being throughout most of the range nearly one-fifth of one per cent.

Owing to the long galvanometer scale and the flexible arrangements of its connections, the range may be considerably extended beyond that given above. For example, a battery of high e. m. f. and a direct deflection method permits of insulation comparisons as high as 20 megohms. The coils are of special wire, carefully seasoned and adjusted to a considerably higher degree of accuracy than heretofore. By suitable connections, the galvanometer or battery may be used independently of the rest of the set or they may be used jointly in series with the rheostat.

A comprehensive pamphlet descriptive of the Queen-Acme set is about ready for the press and will be mailed to all interested parties on application.

Current Economy Due to Change of Car Controllers.

The high economy obtained with the General Electric K2 type of series parallel controller, while fully appreciated wherever the new type of controller is installed, has not, it is claimed, been shown in such concrete shape as to bring conviction home to managers of railway systems using the older rheostatic controllers. The following data from a road which has changed its controllers without material change in its other apparatus will, therefore, prove interesting. In April, 1897, the San Antonio (Texas) Street Railway Company, which had previously used rheostsatic controllers on its cars exclusively, began to substitute the K2 series parallel controller. The cars are equipped with Thomson-Houston F 30 and Edison No. 6 double reduction motors, and were formerly controlled by rheostatic controllers. To supply current to the twenty-six cars in operation required four 125 h. p. Armington & Sims engines driving two 10 k. w. Edison bipolar, and two T. H. M. P. 80 railway generators. The load varied from 450 to 650 amperes and considerable difficulty was experienced in maintaining the pressure at the station at 500 volts.

When K2 controllers were substituted, the load at the station decreased to an average of about 350 amperes, ranging between 270 amperes and 400 amperes, and with so much less rapid variation that with three engines and three generators only, the load is carried with ease. Were it not for several grades of 5 per cent. and 6 per cent. at the extreme ends of the lines, the twenty-six cars in service could as easily be operated by two engines and two generators, but the propulsion of the cars up those grades causes the load to rise above the capacity of the two units. It is worthy of note, however, that when the three units are in service, the use of the K2 controllers allows an increased load of from eight to ten additional cars.

A further benefit derived from the use of the K2 series parallel controllers is the economy arising from repair expenses on the armatures and fields of motors. Mr. W. R. Weiss, president of the San Antonio road, who has kindly given out these facts, says: "No road can afford to continue the old style of controlling apparatus, and, had we known the saving we should make, we should have adopted the series parallel controllers long ago."

Safety Conduit Co.'s Loricated Conduits.

The Safety Conduit Company, Rankin Station, Pa., are the manufacturers of the "Loricated" electric conduits, unlined, and made from standard gas pipe, to which they exactly correspond in thickness of wall and all other dimensions. They are enameled inside and outside with a tough smooth coating which does not crack when the conduit is bent. The tubes are in 10 feet lengths, with a coupling on one end and a thread on the other. The interior of the tube is highly smooth. If need be, light wall tubing can also be furnished, when specially called for. This Loricated conduit, it is claimed, excels all others, in regard to the ease and economy with which it can be installed, and its quality is attested by the fact that it has been approved for use by the National Board of Fire Underwriters. Mr. Robert Garland, the treasurer, informs us that the material has recently been installed in the following important buildings: Post Office,

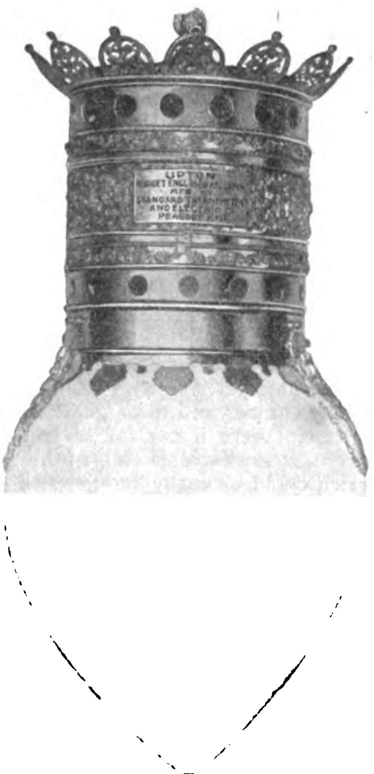
Washington, D. C.; Carnegie Library, Homestead, Pa.; Carnegie Library, Lawrenceville, Pittsburg; Commercial National Bank, Monongahela National Bank, Jos. Homer & Company Building, Pittsburg Leader, all in Pittsburg; and the Eleventh Ward School, Allegheny City. The company is busy on a variety of contracts, and will be glad to receive inquiries and give estimates or other information.

The "Midget" Long Burning Alternating Current Lamp.

THE success which has attended the introduction of enclosed arc lamps for use on low tension direct current circuits, immediately created a demand for an equally good lamp to be used on alternating circuits. In fact a lamp for this purpose, which would meet the requirements in every way, seems to have an unlimited field. In many places where low tension direct current circuits were not feasible, and especially for store lighting, by electric light stations, incandescents have been used, as the old style alternating current open arc lamps were not desirable and made more or less noise. Some manufacturers have recently placed enclosed arc lamps on the market to burn on alternating current, among whom are the Standard Thermometer and Electric Company, of Peabody, Mass., makers of the "Upton" midget lamps.

The accompanying cut represents their lamp designed for indoor service. Elsewhere in The Engineer will be found their outdoor type.

It is claimed that this lamp combines all the elements of simple



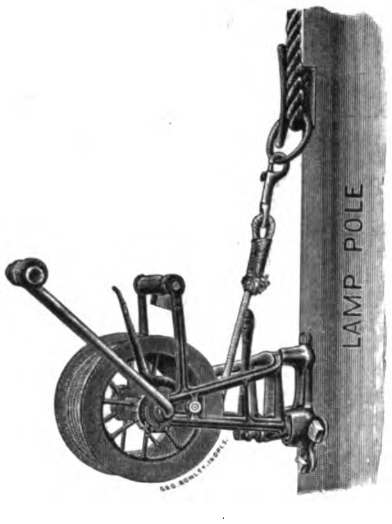
INDOOR TYPE OF "MIDGET" LONG BURNING ALTERNATING ARC LAMP.

mechanism, steady and perfectly noiseless burning with economy of operation.

On circuits of 16,000 alternations the lamp operates direct from a secondary of from 100 to 125 volts without any transformer or resistance at an average consumption of 360 watts per hour. For circuits of 7,200 alternations an induction coil is placed in the cover of the lamp, which otherwise operates like the high frequency type, showing an average consumption of 400 to 425 watts per hour. The makers guarantee for their lamp a life of from 100 to 125 hours at one trimming.

The "Midget" lamp has given the best of satisfaction wherever tried and the "Standard" people claim their lamp has proven successful thus far in all competitive tests. A new catalogue has just been issued which can be obtained by writing either to the main or branch offices of the Standard Thermometer and Electric Company.

Carr's Detachable Windlass.



THE windlass shown in the accompanying illustration is designed to raise and lower electric street lamps for trimming. Only one windlass is required by each trimmer, and it can be attached or detached in a second's time. Each lamp pole is provided with a pole socket or support for the windlass, which is permanently and securely fastened to the pole by three lag screws, and when the windlass is once attached to socket or support it cannot become loosened by accident, making it as safe as if it was bolted directly to the pole. It is very light, strong and neat, being nickel-plated and enameled, and all parts liable to wear are adjustable. The low cost in fitting a street lighting plant with this windlass, makes it within the reach of all, and as the lamp can be raised or lowered without the breakage of globes, suspension wire and the liability of throwing the lamp out of adjustment, this saving alone would soon pay for the windlass. The apparatus is manufactured by E. M. Carr, New Castle, Ind.

Spencer Trask & Co.

This well known New York firm of bankers is one of the largest of its kind and does an extensive investment business. It makes a specialty of dealing in the bonds and stocks of the Edison Illuminating Companies of New York and Brooklyn, the firm having been closely identified with both these properties from their inception. Mr. Trask has been president of the New York Edison Company for fourteen years.

Those desiring information concerning electrical securities, or who wish to invest in them, will be given the closest attention by this representative firm, at 27 Pine street, New York.

When the Wind Blows.

In advertising the Victor split insulator and swinging tree insulator, the Western Electric Company has issued a neat little circular, the cover of which says, "When the wind blows, protect your lines." It is certainly good advice as there is nothing more aggravating to the central station manager than to have the lines break down and cut off the supply of current to the customers.

Red Heat Resistances.

A new type of resistance suitable for sudden overload, and which can be run at almost red heat for an indefinite time, is offered by the Ward Leonard Electric Company, Bronxville, N. Y. This type of resistance is especially suitable for use in connection with motors on cranes, elevators and printing presses, and general motor starting service. It is said to be very compact and of large heat absorptive capacity, while it is well provided with exterior blades for rapid cooling.

C & C Special Motors.

A great deal of work is being done now by the C & C Electric Company, of this city, in the line of special types of machines for special purposes. Among their present orders of this kind is one from the Pope Manufacturing Company, of Hartford, for a big lot of special motors of very light weight and high efficiency to be used in propelling new Columbia motor carriages.

C & C motors have always been well and favorably known for their exceptionally high efficiency, excellence of design and construction and satisfactory operation; and those well known facts have gone a long way in attracting toward the C & C Company many manufacturers of machinery desiring special types of motors for mounting in connection with their own product.

The Wagner Electric Mfg. Co.

A number of changes have recently been made in the management of the Wagner Electric Manufacturing Company, of St. Louis, the general managership of which has been placed in the hands of Mr. S. B. Pike, secretary of the Missouri Edison Electric Company.

Mr. Pike will be seconded by Mr. W. A. Layman, assistant general manager, who will take personal direction of the details of the business in all matters of an executive nature.

Mr. Eugene H. Abadie will devote his entire time and efforts to the sale of the company's products, and Mr. Fred. Schwedtmann, who has so ably conducted the design and manufacture since the company's inception in 1892, will continue as superintendent of the manufacturing department.

Mr. H. A. Wagner, being one of the company's board of directors, will continue his active interests in an advisory capacity.

The Buchil Power and Irrigation Co.

THE Buchil Power and Irrigation Company, of Cuero, Texas, has been incorporated with a capital stock of $50,000. The company has built a power house on the Guadelupe River, whose power can be utilized to the extent of 700 h. p. by the building of a stone and concrete dam giving a 10 foot head. The power house is built of wood on a concrete and brick foundation and has a corrugated galvanized iron roof. At present only one 180 kilowatt generator and apparatus of the Stanley two-phase a. c. type with Stanley transformers have been installed, and the current is to be used for both light and power service.

The power is transmitted over three No. 2 wires from the dam to the city of Cuero, a distance of 3 miles; and there will be 16 miles of circuits for lights. Current will be supplied to a large number of small fan motors, printing presses, etc., and several 50 to 60 h. p. motors to run cotton gins and machine shops will soon be installed. There is no other electricity supply company within a radius of many miles of Cuero and the company is supplying current at a very reasonable rate. The presence of cotton gins as well as cheap power seems to make Cuero a splendid location for the opening of a cotton spinnery. The officers of the company are: Otto Buchil, president, and C. Aug. Buchil, vice-president.

CATALOGUES.

G. E. Decorative and Candelabra Lamps.

ALTHOUGH a very large number of series candelabra lamps are still in use, a growing tendency exists to employ these lamps in multiple on ordinary circuits, with the result that the wiring of fixtures is much simplified, and the renewal of burned out lamps rendered a much easier task. A full line of multiple candelabra lamps, as well as series lamps is now made by the Edison Decorative and Miniature Lamp Department, which has just issued a handsomely illustrated catalogue in which all the styles of series and multiple candelabra lamps, multiple sign lamps, series decorative lamps, and lamps for special uses, such as bicycle, telephone, dental, surgical lamps, and many others, are described. The department has also illustrated in this little work a complete line of receptacles and sockets for candelabra and miniature lamps.

The catalogue is of interest not only to all central station managers and dealers, but also to general customers, whether experimenter, physician or others using or likely to use lamps of this character. The catalogue may be obtained from the Edison Decorative and Miniature Lamp Department, General Electric Co., Harrison, N. J.

ELBERTON, GA.—Pearl's Cotton Mill, Beverly, Ga., is in the market for 10 miles of telephone wire and five instruments complete. Mr. R. A. Field, superintendent of Swift's Cotton Mills, Elberton, Ga., can give details.

Catalogue of the Pawtucket Brass Foundry.

A very handsome and useful catalogue has just been issued by the Vulcan Foundry Company, proprietors of the Pawtucket brass foundry, at Pawtucket, R. I. It contains illustrations and prices of electric railway supplies, line devices, motor bearings and everything in the line of overhead material manufactured by this company. These special and standard productions have been so long and favorably known that they do not require any extended remarks. Mr. D. L. Goff, president, and Mr. Gardiner C. Sims, treasurer, are both well known by the steam and electrical engineering professions.

Montgomery & Co.'s 1898 Tool Catalogue.

One of the most complete and artistically gotten up tool catalogues which has been issued of late is that of Montgomery & Company, 105 Fulton street, New York. It is of a convenient size, contains over 500 pages with thousands of illustrations of all classes of tools and a complete eight page index. Price lists, tables and a discount sheet are included in the catalogue which will be sent to any address for the small sum of 25 cents. In no better manner could the firm give proof of the fact that they are trying to serve the public than by the following statement in the catalogue: "If you are not perfectly satisfied with the way we treat you, write your complaint and 'kick,' and then if we don't straighten the matter out to your satisfaction, get mad; but don't get ugly until 'you know'; 'we know' what is wrong. Sometimes things go wrong and mistakes happen that we never know about until the customer tells us."

The Safety Insulated Wire and Cable Co.

A VERY artistic pamphlet has just been issued by the Safety Insulated Wire and Cable Company, manufacturers of seamless insulated wires and cables. The pamphlet is so folded that the first thing confronting the fortunate receiver is a facsimile of a coil of wire, to which a tag is attached bearing his name and the number of feet and size of the wire. To illustrate the various uses to which their wires and cables are put, the company present half-tone illustrations of a telephone exchange, a telegraph operating room, an electric light station, an electric street railroad, a marine view, the Niagara Falls power station, a police patrol station, buildings at the World's Fair and the following New York buildings: R. G. Dun, Standard Oil, St. Paul, Syndicate, Bowling Green, Postal Telegraph, Mail and Express, Mills Hotel and Singer. Besides these, the pamphlet contains prices and illustrations of wires and cables, wire tables and a large number of testimonials. The typography is excellent, and the pamphlet does credit to the company and its general manager, Mr. L. F. Requa.

Western Electric Arc Bulletin.

A second edition of the Bulletin of Arc Lighting Dynamos has been issued by the Western Electric Company. On the cover is a handsome cut of a dynamo installed in an electric light plant in Detroit, and there are six handsome half-tone engravings which show in detail the various parts of the dynamo. An illustration of an arc light switchboard as built by the Western Electric Company is also given. A complete table is incorporated in this Bulletin giving the number and type of dynamos, the ampere capacity, the size of pulley, the height of the machines, the floor space, and the approximate shipping weight. This Bulletin should be in the hands of everyone interested in arc lighting. It is numbered 1002.

MR. R. LEWIS, of the Telegraph Construction and Maintenance Company, London, arrived here from Bermuda last week on his way home from laying the Jamaica cable. An interesting piece of news about the company to which Mr. Lewis belongs is that they are making preparations for the great Cape and Australian cable; this cable with its various connections will probably be in the neighborhood of 15,000 miles! A new ship is being built for the purpose which is greater than the combined capacity of their two largest boats and will carry 6,000 tons of cable.

MR. GEO. A. McKINLOCK, president of the Central Electric Company, has been in New York recently making business and social calls.

ADVERTISERS' HINTS

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., are doing an excellent business, a proof of which is shown in the list of installations appearing in their "ad."

HENRY W. BUCKLE, St. Paul Building, New York, the sole manufacturer of the Buckley condenser will send a descriptive pamphlet containing useful information to steam users.

A CIRCUIT BREAKER that cannot be closed on a short circuit is quite a novelty. Write to the Ward Leonard Electric Company.

THE NATIONAL CONDUIT AND CABLE COMPANY, New York, present two excellent letters testifying to durability and reliability of their cables.

DESK CLAMPS FOR DESK LAMPS are offered by the Crouse-Hinds Electric Company, Syracuse, N. Y. Switches, switchboards, panel-boards, socket handles and specialties are some of the other goods they call attention to.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., are of course prepared to supply anything and everything required in power, lighting and railway work.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, are in the field with special motors for operating sub-marine boats and torpedoes, blowers and exhausters. Also ammunition hoists and conveyers, ship steering gear and gun carriages.

SOME INDUCEMENTS ARE OFFERED on BB double galvanized iron wire by the Central Electric Company, 173 Adams street, Chicago. It will pay to learn of them.

THE BALL ENGINE COMPANY, Erie, Pa., say, "If you buy the Ball engine you buy the best."

H. B. COHO & COMPANY, St. Paul Building, New York, are always ready to supply complete electric equipments at immediate notice.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., have just issued a very neat little catalogue of electric shade lamps showing some new and attractive goods in this line. Let them send you a copy.

THE FULLER COMPANY, Russell street and Grand boulevard, Detroit, Mich., manufacture all styles of electrical ventilating apparatus.

THE WALKER COMPANY, Cleveland, Ohio, call attention to the contract they have secured for the electrical equipment of the Brooklyn Elevated R. R. The types of motors and trucks are more fully described on another page of this issue.

THE DEARBORN DRUG AND CHEMICAL WORKS, 29 Rialto, Chicago, manufacture a vegetable compound for boilers which has proven most satisfactory where tried.

G. M. ANGIER & COMPANY, Boston, Mass., say the story of the Paragon arc lamps is one long tale of success.

THE DUNCAN ALTERNATING CURRENT INTEGRATING METER is recommended as the best on the market by the Fort Wayne (Ind.) Electric Corporation.

A HOT TIME is out of the question where the Bates electric fans are installed. So say D. L. Bates & Brother, Dayton, O., who manufacture them for any voltage, direct or alternating current.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., say the words "Hart Switch" represent a profit to the user.

DE VEAU & COMPANY, 27 Rose street, New York, are better prepared to furnish their telephone apparatus and supplies. An account of their new factory may be found elsewhere in this issue.

THE ROBBINS & MEYERS COMPANY, Springfield, O., are out with their 1898 type of ceiling fans.

WHEELER REFLECTOR COMPANY, Boston, Mass., advertise special shaped reflectors for special purposes.

THE NATIONAL CARBON COMPANY, Cleveland, O., illustrate their No. 2 style of battery and suggest the trial of a few.

"DON'T TRAVEL—TELEPHONE," is the advice of the New York Telephone Company.

DIRECT-CONNECTED POWER GENERATORS of all sizes and voltages are advertised by the Crocker-Wheeler Electric Company, New York. Motors from 1-12 h. p. up.

GENERAL ELECTRIC COMPANY, New York, present a variety of enclosed arc lamps to suit the very requirements of service.

STANDARD THERMOMETER AND ELECTRIC COMPANY, Boston, Mass., show an outdoor type of the "Midget" enclosed arc lamps.

WESTERN NOTES

THE CENTRAL ELECTRIC COMPANY, Chicago, are carrying complete stocks of Insulac and Armalac, for the insulation of generators, motors and all kinds of high potential work. These two compounds are fast establishing a reputation for permanency and absolute reliability.

CENTRAL ELECTRIC COMPANY, of Chicago, is prepared to furnish from stock India or Amber mica, cut or uncut, in rings, washers or any other standard form, a specialty being made of standard shapes for commutators.

WESTERN ELECTRIC COMPANY is at present recommending an electric spud as a serviceable construction tool. This spud is in the nature of a digging bar provided at one end with a braid of open hearth crucible mining steel, and on the upper end an iron tamper, thus combining a digging bar and a tamping bar in one tool. The length of the spud is 9 feet and it digs three times as fast as an ordinary bar and is only half as heavy. The company are carrying in stock a large supply of Simplex friction tape and Simplex splicing compound. They are also pushing the Tuerk alternating current ceiling fan, for which they have recently received orders from Japan and inquiries from Australia.

WESTERN ELECTRIC COMPANY'S desk fan motors of 1897 were received by the trade with such approval that a strong demand already exists for their improved fans of 1898. They manufacture desk and bracket fans for 110, 220 and 550 volts, also ceiling and column fans. The column fan has two speeds, while all the other fans have three speeds. The 12 inch desk fan for 1898 requires less current to operate it than is used by a 16 c. p. incandescent lamp. This economy over fan motors of the past three or four years shows a great improvement in mechanical detail as well as electrical design. The Western Electric Company will soon issue a 32 page fan motor catalogue listing direct and alternating current fan motors, also battery fan motors, and those interested in fan motors will do well to write for a copy of this catalogue.

THE IOWA TELEPHONE COMPANY celebrated on February 11, in connection with the American Telephone and Telegraph Company, the extension of the long distance lines connecting Cedar Rapids with the principal cities East of the Missouri River.

ST. LOUIS, MO.—The Mississippi Valley Elec. and Mfg. Co. has been formed, with a capital stock of $100,000, half paid up, to make the electric railway appliances and inventions of Mr. John R. Farmer, who has a system to dispense with overhead wires.

"SHADE LAMPS" is the title of a very dainty little catalogue just issued by the Electric Appliance Company, covering their special lines of Espersen, Klemm and Dale electric portables and shade lamps. It is a valuable catalogue for any user or dealer in these goods and will be sent on application.

CINCINNATI STREET RAILWAY COMPANY has closed a contract with the General Electric Company amounting, it is said, to over $100,000. It covers the necessary electrical apparatus to enable the Cincinnati company to change over that portion of its system now driven by cable, the Walnut Hills line, to an electric system. The Boston Elevated Railway, has also placed a contract with the same company for electrical apparatus amounting to the same sum.

MR. R. C. FOSTER, of the Cornman Company, of Cleveland, was a visitor at the Chicago office of The Electrical Engineer last week.

MR. W. R. GARTON has located at 414 Ashland Block, Chicago, where he will represent the Garton-Daniels Electric Co., the Pittsburg Steel Hollow Ware Co., the Massachusetts Chemical Co., and other Eastern manufacturers. He will also sell B. & S. drop forged commutator bars and electric railway

supplies in general, but will not give any attention to minor supplies or repair parts. He is interested in the Raster Carbon Rheostat Co., and is also consulting engineer for that concern. At the last meeting of the Garton-Daniels Co. he was elected general manager.

MILWAUKEE, WIS.—The Edward P. Allis Company are building a huge engine to drive the big new General Electric generator of the Louisville, Ky., Railway Company. It is a vertical, round column cross compound machine, with cylinders 40 x 78 x 48, and wheel 25 feet in diameter, weighing 160,000 pounds. The engine shaft is 27 inches in diameter. It is similar to four supplied to the Metropolitan West Side Elevated Road about three years ago.

PORT HURON, MICH.—The St. Clair Tunnel Company is contemplating converting the motive power for the tunnel from steam to electricity. Ever since the awful casualty of Nov. 28 the officers of the tunnel company have given the subject of electrical propulsion considerable attention, and they have now about decided to equip the tunnel with electrical power at as early a date as practicable. Joseph Hobson, of Montreal, chief engineer of the tunnel company, who has charge of the matter, has visited the tunnel with representatives of the General Electric Company, and a thorough survey was made.

CRESTLINE, O.—Mr. R. C. Foster, president of the Cornman Company, of Cleveland, O., has just taken a ten years' contract for an electric lighting plant at Crestline. The Cornman Company have the contract for the electrical apparatus, and station buildings will shortly be erected. The People's Electric Light and Power Company of Crestline is to be the name of the new local corporation.

LOS ANGELES, CAL.—The Edison Electric Illuminating Company has made a contract with the Alcatraz Company for the construction of a complete conduit system. It is said that the cost will reach $150,000.

KANSAS CITY, MO.—C. S. Sweetland, Benjamin Friedberg and R. J. Ingraham have applied to the city council of Kansas City, Mo., for a franchise to operate an electric lighting plant. They would, if successful, probably enlarge the plant in Kansas City, Kan., where Mr. Friedberg is at present operating. They offer 20 per cent. of the gross receipts to the city.

THE NICHOLASVILLE, KY., TELEPHONE COMPANY, Incorp., has recently been started with a capital stock of $10,000. It has equipped a 100 drop exchange, with apparatus of the American Electric Telephone Company, and has started with 35 subscribers. The rates are $1.50 per month for dwellings and $2 for offices, etc. J. A. Kelly is president, of Lebanon, Ky., and R. Y. McElroy, vice-president. The exchange is over the Farmers' Exchange Bank. There is an opening in the town for an electric light plant.

CLEVELAND, O.—The Lorain and Cleveland Road illustrated and described in The Electrical Engineer last October is said to be the fastest electric line in the world. Its cars run on some sections of the road regularly at the rate of 55½ miles an hour.

NEW ENGLAND NOTES

KENT ELECTRICAL MANUFACTURING COMPANY. —We regret to note that a fire at the factory of the Kent Electrical Manufacturing Company, Worcester, Mass., on February 18, practically destroyed the place and with it their stock of motors. Since then, Mr. A. A. Kent, the manager, informs us, the company have been at work in temporary quarters, as they have a large number of orders on hand for prompt delivery. "We have," he says, "been pushing things since the fire in such a manner that we think, from the shipping standpoint, we shall be back where we were in about two weeks."

BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., are building a new boiler house roof for the Coe Brass Manufacturing Company, at Ansonia, Conn.

CENTRAL STATION MANAGERS find that by using an enclosed lamp for their series arc circuits for commercial work, quite a saving is accomplished. The Paragon enclosed arc lamp for series circuits is having a very large sale among the leading electric light stations. Messrs. G. M. Angier & Company, selling agents, Boston, report that every mail brings them inquiries in regard to their new lamp.

NEW YORK NOTES

THE WARREN-MEDBERY COMPANY, of Sandy Hill, N. Y., has been incorporated to make and deal in electrical apparatus and supplies of all kinds. Its capital stock is $25,000, consisting of shares of $100 each, and the directors for the first year are H. J. Medbery and S. C. Medbery, of Ballston Spa; H. B. Warren, of Yonkers, and W. H. Cunningham, H. E. Tidmarsh, Lincoln Paris and George W. Wait, of Sandy Hill.

VALATIE, N. Y.—The Columbia Electric Power Company, of Valatie has filed a certificate with the Secretary, setting forth that its capital stock, amounting to $100,000, has all been paid in. Its directors include Charles Wild, William H. Wild and George M. Pinney.

MR. E. P. THOMPSON, and Mr. A. C. Coursen, will in April take a suit of offices in the Market and Fulton Bank Building, at 81—83 Fulton street, to secure more room for their growing business in patent law, general law, and mechanical and electrical experting. They have of late been very busy in patent suits.

THE WARD LEONARD ELECTRIC COMPANY thought they had lots of room when they bought the large buildings in Bronxville, but their circuit breaker business has grown so rapidly, the need of more buildings is already felt.

OTIS ELEVATOR COMPANY have been awarded a contract for the electric elevators in the extension to the Bamberger Building, Newark, N. J. There will be five, and the price is said to be $13,000.

MR. F. M. HAWKINS, sales agent for Pass & Seymour and The Crouse-Hinds Electric Company, having found his quarters at 41 Cortlandt street too small for his constantly increasing business, has moved his stock and office to the ground floor store, 23 Dey street, where he has ample room to carry and keep in stock a full line of the above firms' specialties. Mr. Hawkins reports business as good and improving.

THE MICA INSULATOR CO., of 218 Water street, New York; 117-119 Lake street, Chicago, and 12 Camomile street, London, report a heavy increase in the volume of business. Many of the large manufacturers are using their "Micanite" segments in the construction of generators and motors exclusively. The company have made many valuable improvements in their well-known insulation, "Micanite," and are turning out a very fine commutator segment. They would be pleased to send a set of segments for any of the smaller machines, as sample, to electrical manufacturers or repair concerns who may make application. Their M-I-C friction tape and "Empire" cloth are meeting with a large sale. They are used for the winding of fields and armature coils, and ensure the highest possible grade of insulation.

STATEN ISLAND.—The New York and Staten Island Electric Company, in February, 1897, contracted for the installation of about 1,200 h. p. Cahall-Babcock & Wilcox type of boilers in their power station, additional. The company shortly after doubled their order, and now, just about a year later, have given the Cahall people a third order and also a contract to dismantle some other old boilers and rebuild them into Cahall-Babcock & Wilcox type.

MR. W. A. GILES, well known as an electrical and mechanical engineer, has joined the staff of the American Stoker Company, of Brooklyn, whose apparatus is now attracting wide attention and is in great demand.

WARD LEONARD ELECTRIC COMPANY, of Bronxville, Westchester county, has been incorporated; capital, $100,000; directors, H. Ward Leonard, Charles E. Carpenter, Richard H. Mansfield, Jr., and Henry Price Ball, of Bronxville, and H. A. Wise, of New York.

THE COMPLETE WIRING SYSTEM, as established and standardized by the Interior Conduit and Insulation Company, will be installed exclusively in the new Park Row Building, the largest office building in the world. Some 250,000 feet of interior conduit will be used in the installation, which will be made by the New York Electric Equipment Company. The Sprague high speed, vertical, electric elevators will also be used in this building.

THE MACKAY TOMB.—A permit has been granted to the Edison Company, of Brooklyn, to lay wires to the famous Mackay mausoleum in Greenwood Cemetery for the lighting

and heating of the tomb, which is now nearing completion. The wires will be laid in a trench 800 feet long. An altar is to be erected in the mausoleum, and a priest will be assigned to say a requiem mass daily.

ERIE CANAL TRACTION COMPANY held its annual meeting last week and elected, president, Louis A. Von Hoffman; vice-president, Frank W. Hawley; secretary and treasurer, C. T. Lewis, and general manager, Com. P. Vedder. Plans are under consideration from the Walker Company to operate the Short system of electric traction on the Champlain Canal. The Trenton Iron Works have submitted also the Lamb system.

BATAVIA, N. Y.—The Bell Telephone Co., of Buffalo, N. Y., have extended a toll line, connecting Bergen and Churchville, which was opened for service February 5. Batavia has a population of 8,250 by recent enumeration; the Bell Telephone Co. has 225 subscribers, which makes a ratio of one telephone to every 37 inhabitants, a very high percentage.

PHILADELPHIA NOTES

WILMINGTON, DEL.—The Jackson and Sharp Company have shipped eight electric cars to the Pensacola Electric and Terminal Railway Company, of Pensacola, Florida. They are handsome in finish and elegantly equipped. Four of the cars are of the open style, 30 feet long and contain ten benches. The remainder are closed cars, and are 18 feet 6 inches long. All are mounted on Peckham trucks, and are finished in orange on the outside.

THE UNITED ELECTRIC IMPROVEMENT COMPANY have built up a business with their series and multiple lighting incandescent lamps, which has outgrown their present facilities. They are contemplating extensive additions to their works.

PITTSBURG, PA.—The Westinghouse Electric and Manufacturing Company has a contract for three dynamos, with a total capacity of 3,000 lights, for the Bellefield Hotel Company, and the order for engines has been placed with the Ball Company of Erie.

SAFETY CONDUIT COMPANY, Rankin Station, Pa., have installed their "Loricated" conduit recently in the Post Office building at Washington and the Carnegie Library at Homestead. They are busy on a large number of orders.

FOREIGN NOTES

PACKARD ELECTRIC COMPANY, St. Catharines, Ont., E. E. Cary, manager, has started and fitted up an electric club for its members. It is fitted up with books, papers, etc., and there are recreation grounds attached. Mr. Cary is honorary president, Mr. Bingay, president, and Mr. Frank Adams, vice-president.

AHEARN & SOPER.—The contract for all the work in connection with the lighting of the Parliament and Department Buildings, at Ottawa, Canada, has been placed with Ahearn & Soper.

SOUTHERN NOTES

KINGSBURY, SAMUEL & COMPANY.—Messrs. L. L. Kingsbury, S. Herman Samuel and George Reese, who for a long time had charge of the electrical construction department for the Southern Electric Company, have severed their connection with that concern and opened an office at 204 East Lexington street. They will confine their business to electrical engineering and contracting. The Southern Electric Company have abandoned that branch of their business. The new firm have the contract for wiring the new government post office at Washington.

NATIONAL AUTOMATIC FIRE ALARM COMPANY, of Louisiana, 618 Gravier street, New Orleans, has been good enough to favor its friends with a neat box of pencils.

THE CITY OF HARRIMAN, TENN., has sold bonds to install an incandescent light plant of 1,500 lamp capacity. Manufacturers and contractors can obtain information of City Clerk D. W. Thomas.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. MARCH 10, 1898. No. 514.

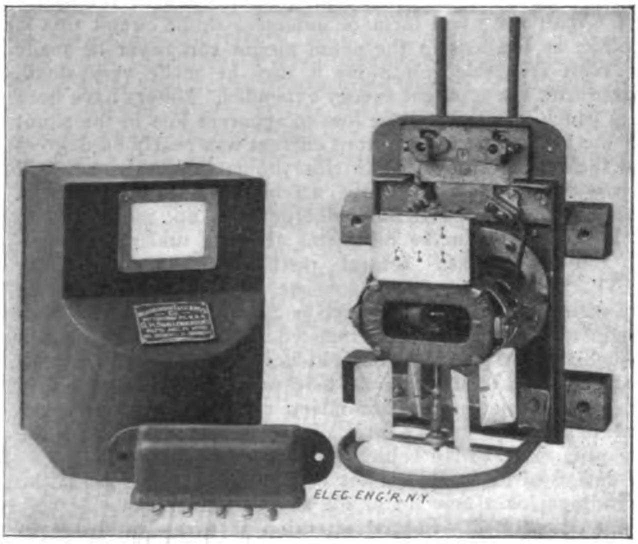
MISCELLANEOUS

The Late O. B. Shallenberger and His Work.

THE recent death of Mr. O. B. Shallenberger removes an inventor who is most widely known through his inventions in electric meters for alternating currents. His current meter, which was developed in the earliest days of the new alternating current system, has never been excelled in simplicity. Over 130,000 have been put into commercial service, and the annual charges for current based on their registration probably exceeds $10,000,000.

This meter was invented in the spring of 1888. It is difficult to appreciate now how little was then known of alternating current phenomena, and how truly those who were producing alternating current apparatus at that time were pioneers. There was practically no literature on the subject, established theories and principles were few, experience was very limited. The only measuring instruments were the Cardew voltmeter and the Siemens dynamometer. To perceive and grasp the underlying facts and fundamental principles in curious and perplexing phenomena, and to apply them to a definite purpose, and construct from them new and useful forms, requires peculiar insight and genius.

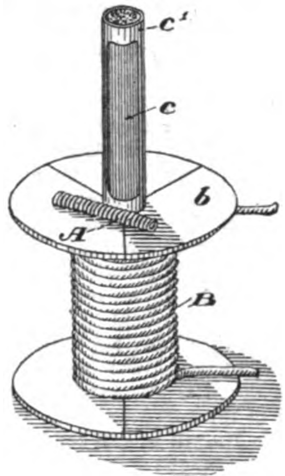
The rotation of a spiral spring which accidentally fell on the top of an experimental arc lamp would have escaped the attention of most people, or would have simply received passing notice as something strange and peculiar. Mr. Shallenberger noticed the action, he investigated the conditions, he foresaw possibilities, he determined the principle, he devised new forms. He possessed to a rare degree the ability to translate ideas into simple mechanical forms. The simplicity and the integrity in the apparatus which he constructed were the legitimate product of his keen and clear-sighted method of thinking.



SHALLENBERGER CURRENT METER.

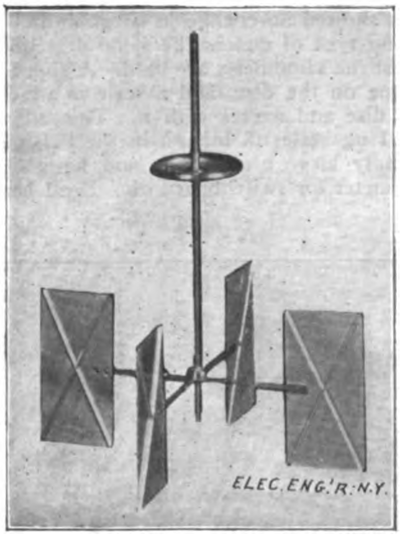
It is seldom that any device stands without change for ten years and without a serious rival. This is particularly true in electrical apparatus during a decade which has seen evolution and revolution everywhere. And yet the Shallenberger current meter, which was invented, experimentally developed and mechanically designed in the short interval of two or three months, had such intrinsic excellence that it has remained unchanged in form or size or other particular, except a few mechanical details. Other successful meters embody elements of design first used in this meter.

Considered simply as a mechanical device the Shallenberger meter is exceedingly interesting. It is a miniature induction or rotary field motor, in which the moving parts, while having no contact with the actuating circuit, are carried around by the rotating magnetic field which surrounds the iron ring armature



COIL, CORE AND ROTATING SPIRAL SPRING WHICH SUGGESTED THE PRINCIPLE OF THE SHALLENBERGER CURRENT METER.

on the meter shaft. This driving force varies as the square of the current, and to make the speed of the meter proportional to the current, retarding air fans are employed, which have a retarding force proportional to the square of the speed. Omitting bearing friction, the driving and retarding forces balance each other at all speeds, and by a simple comparison it is found that the square of the speed varies as the square of the current or the speed of the meter varies as the current. In designing this meter other damping devices were considered and experimented upon, but the simple air fans were found the best. The delicacy



MOVING PART OF SHALLENBERGER INTEGRATING WATT-METER.

of the meter is best illustrated by the amount of power required for the moving parts at full speed. It is only 1-200,000 of a horse power.

In a current meter it must be remembered that the torque or turning force varies as the square of the current, and at starting this is extremely small. As an example: at 1-25th of full load current the torque is 1-625th of that at full load. It is only by very light moving parts and perfect jewel bearings that a meter will start with this current. The form of the lower bearing

enables this delicacy to be secured, and with any other known form the meter would be a failure. The end of the shaft is approximately a hemisphere and rests in an agate or sapphire cup of slightly greater curvature. The weight of the meter shaft, armature and fans is but a little more than one ounce.

Special care is also given in selecting the quality of iron used in the meter discs, as upon this depends the uniform registration with different loads. Hundreds of discs have been measured. Each grade of iron requires a different thickness of disc for the best effect.

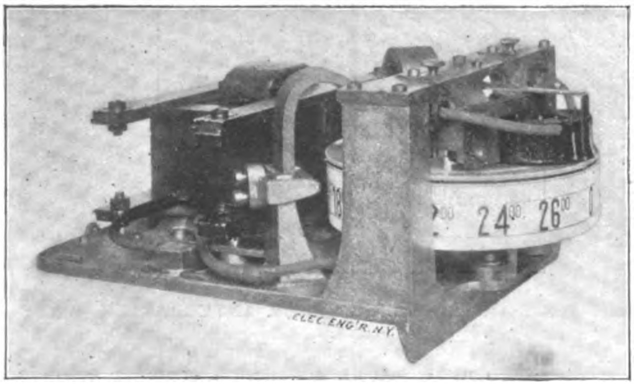
On account of the general introduction of alternating current motors taking currents which may not be proportional to the power delivered, the Shallenberger integrating wattmeter was designed. In this meter lightness of moving parts and the form of jewel bearing which was so successful in the current meter, are retained. It is a peculiar form of two-phase induction motor, in which the rotating part is a plain disc of sheet aluminum. This disc is placed within the shifting field developed by the shunt and series currents, and is carried along by the eddy currents developed within it. There is no connection between the moving parts and the actuating circuits.

The magnetic field derived from the shunt current has such a phase relation to the field of the series current, that the torque on the meter disc is always proportional to the power which this current conveys, independently of any lag which may occur. As the torque is proportional to the power passing the meter (and not to the square of the current) the wattmeter starts with less current than is required in the current meter. With 1-625th full load current the torque is 1-625th of full load torque, and with equal weights of moving parts, the wattmeter has great superiority in starting, over the current meter, which is not due to difference in construction, but in its law of operation.

Retarding force is applied to the disc by two permanent magnets which embrace the disc between the poles. In this way effects of temperature tending to change the speed of the meter are neutralized, since the driving and retarding forces are affected equally. These magnets are of special steel and are artificially aged, by which permanency in strength is secured, which is very important since any change in strength immediately changes the meter speed.

In developing the methods for making these magnets, which occupied several months, Mr. Shallenberger devised a weighing instrument, depending on the force on a conductor carrying a current in a magnetic field, by which the strength of magnets could be measured accurately within 1-10 per cent. In this way any changes in strength could be detected, but magnets were soon made which showed no change in six months.

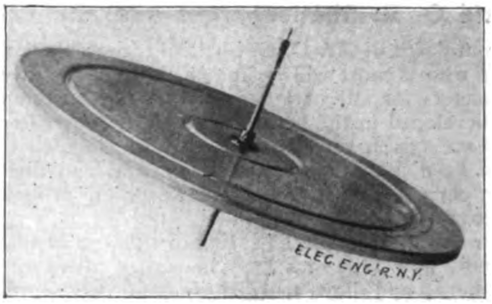
In the indicating type of meters the same principles are employed, and almost the same parts are used. A spiral hairspring opposes the torque on the disc, and a scale is attached to the periphery of the disc and moves with it. This allows the use of an extremely long scale, 18 inches, in the "Niagara Type," and correspondingly large graduations and figures, making a very satisfactory meter for switchboard use. Dead beat qualities



SHALLENBERGER INTEGRATING WATTMETER.

are secured by retaining the magnet used in the integrating meters.

A temperature compensation is required in the indicating meters for variation of resistance in the disc, and Mr. Shallenberger accomplished this in a very beautiful manner by compensating the inductive coil in the shunt circuit, so that more current is allowed to flow as the temperature increases. Other factors remaining the same, the current in the inductive circuit varies as the air gap in the magnetic circuit of the inductive coil, and this change is secured by the difference in the expansion of zinc and iron rods. A variation of only 4-1,000ths of an inch in the air gap of the inductive coil compensates for a variation of 50 degrees Fahr. When this compensating device was



MOVING PARTS OF SHALLENBERGER CURRENT METER.

first made it was found that different instruments were not equally compensated, and the cause was a mystery until it was discovered that in some instruments the zinc strips had been cut with the grain of the metal and in others across the grain.

In order that an induction wattmeter may operate accurately on loads having different power factors, it is well known that the shunt field must be exactly in quadrature with the shunt e. m. f. With the usual form of inductive shunt circuit this is impossible, as the loss in the shunt circuit can never be made zero. With favorable conditions it may be made very small, compared with the apparent energy expended. Meters have been made in which the ratio of true loss to apparent loss in the shunt circuit was .09, or the lag of shunt current was nearly 85 degrees behind the shunt e. m. f. With this shunt circuit a meter will register with fair accuracy on any current commonly met with in commercial practice. Mr. Shallenberger was not satisfied with this. He wished to make his meter accurate under all conditions, and he devised several methods of accomplishing this. That usually employed consists of a small closed secondary within the shunt coil, which is adjustable, either in position or in resistance. Currents induced in this secondary lag in phase behind the magnetic field inducing them, and the new component added to the original field produces a resultant field which, by adjustment of the secondary, may be brought in exact quadrature with the shunt e. m. f. Thus the effective field of the shunt coil is made to lag behind the current in that coil.

The design of these meters has been so systematized that the best windings for a new meter for any particular capacity may be easily determined. Special attention is given to losses in the shunt circuit. While this is small, it goes on constantly when the meter is in service. A smaller loss also implies less compensation to obtain a lag of 90 degrees in the shunt field, and hence less variation due to changes in frequency. Only about three true watts is required in the shunt circuit of any meter, and this decreases as the frequency on which the meter operates is increased. This loss is usually equally divided between C^2R loss in the winding and iron loss in the core of the inductive coil.

In all apparatus made by Mr. Shallenberger there is an admirable completeness in execution. There was usually but a single step from the first model, in which approximate dimensions and laws were determined, to the final working apparatus. There was an absence of successive experimental steps in the development of an instrument, which denotes rare insight into details and foresight in design.

The work of Mr. Shallenberger in connection with meters and electric measuring instruments is that by which he is best known. This was, however, but a small portion of his contributions to applied electricity. In the early days, when there was little theory and less experience on which to base opinions, Mr. Shallenberger, exercising his keen insight and excellent judg-

ment, attained results which have stood the test of time. The design of the early generators and transformers and auxiliary apparatus in the alternating current system, is largely the product of his work. At that time the alternating current system was little known and was the object of intense commercial opposition and the ridicule of many experts. It was in a large measure Mr. Shallenberger's work which gave the alternating current system the initial success which paved the way for its present wide use in this country.

We are indebted to the Westinghouse Electric & Manufacturing Company for thhe above interesting details regarding the late Mr. Shallenberger's pioneer work. We believe with that company that no greater tribute can be paid to the memory of the deceased than to record his work which has accrued to the benefit of the whole world.

An Early Rising Persuader.

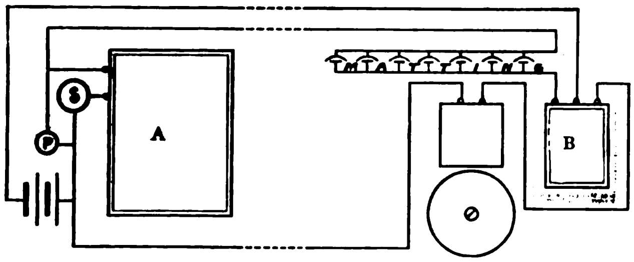
BY RAY D. LILLIBRIDGE.

IN devising an apparatus that will absolutely compel my arising mornings at a regular set time, I believe that I have overcome a difficulty which has never been successfully surmounted before. To be sure we have heard stories and verses of automatic folding beds which, after forcibly ejecting their occupants, snap shut and are only released after the time lock has run down; but it is more often we hear of actual cases where such affairs snap shut without any pretense at delivering their occupants in one piece out into the ambient atmosphere.

Some time ago, after considerable complaint about my failing to respond to gentle entreaties to "get up" mornings, I purchased one of the ordinary electric alarm clocks, which close a bell circuit at any time set and which, with battery and bell, make it necessary for one to arouse sufficiently to throw off the switch.

For a time—till the novelty wore off—this worked very well, and I was declared a "model man," so far as getting up mornings was concerned. But then, notwithstanding that the clock was advertised "a good time keeper," it was very severely affected by changes in temperature, losing or gaining from 20 to 30 minutes as the weather ordained. Besides it had to be wound every day, and when one comes home in the wee hours he hardly feels like giving fourteen screws to an arrangement which is to awaken him in a few hours.

With cold weather came the temptation to crawl back to bed again and have another nap. There is some non-explainable delight, a grim satisfaction, in a few minutes' sleep when you know you are sleeping. Just the dim consciousness that you should be up and around, mingled with the comfort of your situation, that makes you enjoy your stolen nap far more than



(A) CABINET CLOCK. (B) AUTOMATIC DROP.

any other portion of your night's sleep. After once indulging, it is really a task to break off from the habit. It didn't take long to make the "electric alarm clock" obsolete.

My next move was to place an automatic drop away over in the corner of my room furthest away from the bed, and provide the kitchen with a push button. Touching the latter dropped the drop, which in turn threw into circuit a four-inch bell over the headboard of the bedstead. To stop the bell ringing I must lift the drop, and if I chose to go back to bed another push would compel my arising again.

For a long while this arrangement worked admirably. Then we got a girl who couldn't understand why she should push that button more than once (if she thought to do it at all). All the orders, threats or entreaties couldn't make her see that she was hindering the progress of the household by her forgetfulness or maliciousness.

After inconvenience and loss from not being on time in town when I was needed, I conceived the idea herewith illustrated and described. It has been working both summer and winter, and has yet to fail me, notwithstanding that on several mornings I have actually tried my best to "get around" it.

First I took a good cabinet clock that had a mechanical alarm, and connected thereto an electrical attachment, so arranging it that they might work either independently or together. I finished the job up nicely, placing binding posts on the side of the frame and concealing all wires, etc. The clock is an excellent timepiece and has been in actual service some years. For two reasons I left it in its old place on the kitchen clockshelf. One reason was that it might still set the household time; the other that I might not open the circuit at the binding posts in case of a particular lazy spell.

It may be noted in the diagram that all connections, such as battery, switch, etc., are with the clock, two flights downstairs, excepting those on the bell and the automatic drop. These I tightened with a pair of pliers so as to make unscrewing with the fingers absolutely impossible. I then purchased 2½ feet of 36-inch burglar alarm matting, and placed this between the mattress and spring of my bed, putting it in circuit with the automatic drop by means of flexible cord. The pressure of bedclothes, mattress, etc., is not enough to make a contact, but to put one's weight on the bed is sufficient.

The clock may be set to close the circuit at any hour and it keeps it closed for about one hour. At present I wish to arise at seven o'clock, the circuit is therefore closed from seven to eight and open between the hours of eight and seven. Sunday mornings I sometimes like to sleep later than on other days, and by throwing off switch S the night before, I am not disturbed. The button P is, however, easily pushed, but will only work when some one is in the bed. This by itself is a great item. Many times, prior to the installation of the matting, meddlesome fingers had pushed that button, necessitating a trip upstairs when no one was there to stop the bell ringing. Or worse yet; causing the bell to ring till the battery run down. The clock naturally closes the circuit at seven in the evening, but as it is open at the matting the drop does not fall.

I may be retire as early as eight o'clock and will be awakened at precisely seven the next morning by the four-inch gong, to stop whose ringing I must cross the room and lift the drop. Now, should I go back into bed, the contacts in the matting will immediately close the circuit, dropping the drop, starting the bell which will continue its ringing till the drop is again raised.

In practice I find that once knowing that it's "all up" and there is no use trying to get back to bed, I don't make the effort, but at once begin preparations for "business" and soon forget all about sleep. Should anyone install a similar arrangement I will be glad to hear their experience.

The Hargreaves-Bird Electrolytic Alkali Process.

THE experimental plant at Farnworth, near Widnes, England, for the production of alkali and chlorine in the Hargreaves-Bird form of cell by the electrolysis of common salt, was recently inspected by John B. C. Kershaw, F. I. C., who gives the following interesting account in "The Electrician" of the details of the plant and its working results:

The plant has now been running at Farnworth almost continuously for over two years, and many improvements in details of form and working have resulted from the experience gained during this long period of trial. The power at Farnworth is supplied by a gas engine of the well known Otto type, running at 175 revolutions per minute and generating 20 h. p. This engine drives a dynamo made by Holmes, of Newcastle, by belting, the mean speed of the dynamo being 350 revolutions per minute, and the output 2,200 amperes at 5 volts pressure. There is considerable loss of energy occurring in the dynamo at Farnworth on account of the low voltage required. When a large number of decomposing cells are coupled in series it will be possible to utilize currents generated at from 50 to 100 volts pressure, and an efficiency of 94 per cent. will no doubt be attainable. There is also some unnecessary loss of energy in the conductors, a drop of 0.35 volt being observed in the comparatively short lead between the dynamo and the electrolytic cell. Copper conductors of 2¼ square inches sectional area are used. The electrolytic cell in which the whole of the electrical energy delivered by this conductor is being utilized is raised by a brickwork foundation about 2 feet from the ground, and is internally 5 feet deep, 10 feet in length and 14 inches in breadth.

It is divided into one inner anode chamber and two outer cathode chambers, in the manner described in the previous article on this process. The figure represents diagrammatically a vertical end section of the cell with one of the anodes in position in the anode chamber. This inner chamber of the cell is almost filled with the brine, which is maintained in continual circulation through it, and at a constant level. The outer cathode chambers are kept constantly supplied with steam and carbonic acid gas (the exhaust from the gas engine supplies the latter at Farnworth); the solution of sodium carbonate formed on the wire gauze cathodes collects at the bottom of the chambers, and is continually running off by the pipes shown in the diagram. The diaphragms are 5 feet 4 inches by 10 feet 4 inches, including overlap at the edges, leaving 5 feet by 10 feet of active surface inside the margin. Mr. Hargreaves considers these dimensions as large as are practicable at present, but they may, no doubt, be increased when more experience in handling them has been acquired. The cathode area in the cell at Farnworth with two of these large diaphragm-cathodes is, therefore, 100 square feet. The anodes at present in use are compound ones, formed by boring perfectly round 3-inch holes in a number of roughly-shaped blocks of gas carbon, and by fitting these upon a round shaft of lead-copper alloy. A special cement is used to protect this shaft from the action of the brine and chlorine, in parts that would otherwise be exposed. This novel form of anode, the general appearance of which is shown in the figure, is the invention of Mr. Connor, of Belfast, and the patent is now owned by the General Electrolytic Parent Company, who likewise control the Hargreaves-Bird patents. A row of six of these compound anodes connected in parallel extends from side to side of the anode chamber, and they are said to be much superior in every respect to the flat plates of carbon which were formerly used. The chlorine gas produced at the anodes rises to the surface of the liquid, and is led away by the pipe which carries off the overflow of the brine. The brine and chlorine are conducted to a separating well, where the brine is re-saturated with salt, and is returned by a pump to the cell, while the chlorine gas is led to an absorbing chamber or tower, for the production of bleaching powder or chlorate of soda. At Farnworth it is possible to use the chlorine produced in the cell for either purpose, and on the occasion of the writer's visit bleaching powder was being produced. Both the bleaching powder and chlorate manufactured by the plant in operation at this place are stated to have been of excellent quality. The alkaline liquor flowing from each cathode compartment of the cell was sampled in the presence of the writer for the London "Electrician," and found

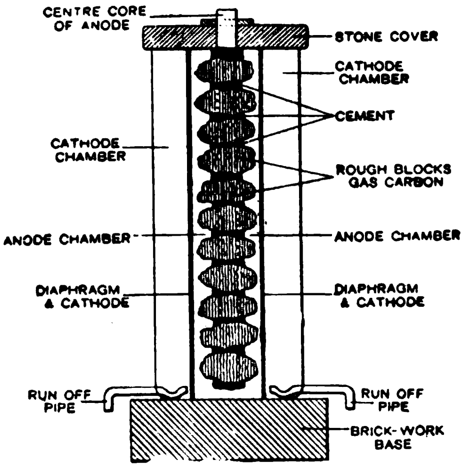


FIG. 1.—DIAGRAMMATIC VERTICAL SECTION OF THE HARGREAVES-BIRD ELECTROLYTIC CELL.

to possess a specific gravity, in one case of 1.125° and in the other of 1.112°, measured hot.

These samples were bottled and sealed, and have since been tested with the following results:

Mean Sp. Gr.	Mean Percentage Na_2CO_3.	Mean Percentage Na Cl..	Molecules Na Cl per 100 Mol. Na_2CO_3.
1.125	10.90	0.94	15.6

The amount of undecomposed salt in these samples was very much higher than that found under normal working conditions. The increase was attributed by Mr. Hargreaves to the use of the diaphragms ten days longer than was customary. Those in use on the occasion of this visit had been in the cell from October 12—that is, for a period of forty days; whereas the diaphragms were not usually worked beyond thirty days, and this was regarded as the limit under normal conditions of work.

In order to obtain further information upon this point, the writer paid a second visit to the works on January 7, and obtained samples of the liquor flowing from the cell as before. The diaphragms on this occasion had only been in use thirty-six hours, and were practically quite new. The samples were bottled and sealed; the tests have yielded the following results:

Mean Sp. Gr.	Mean Percentage Na_2CO_3.	Mean Percentage Na Cl.	Molecules Na Cl per 100 Mol. Na_2CO_3.
1.094	10.44	0.10	1.73

The molecules of undecomposed salt per 100 molecules of sodium carbonate are in this case very low, and the figures therefore support Mr. Hargreaves' statement, that under normal working conditions as regards the age of the diaphragms, the proportion of undecomposed salt in the solution of alkali flowing from the cell can be kept within satisfactory limits.

The current passing through the cell on the occasion of the second visit was 1,800 amperes, and the e. m. f. at the cell terminals was 5.40 volts. It was stated that the e. m. f. necessary to overcome the resistance of the diaphragms would diminish as they became older, and that consequently the amperes of current passing through the cell would increase. Neither free chlorine nor hypochlorite were present in any of the samples of liquor taken from the cathode compartments of the cell.

At Farnworth this alkaline liquor is boiled down and is then allowed to crystallize. Sodium carbonate with 10 molecules of water (the deca-hydrate) is obtained. It is optional whether this form of alkali, soda ash, or caustic alkali shall be produced by the process, and the decision in the case of the larger plants which are about to be built will depend upon the relative market-sale prices of these products.

The quantity of salt decomposed in the cell now working at Farnworth was stated to be about 220 pounds (dry) per twenty-four hours.

The following figures represent the details of the previous run and of the one in progress at the date of the writer's first visit. The cell is run continuously, seven days per week, until the diaphragms require renewal.

Period of Run.	Mean Current Amperes.	Mean E.M.F. Volts.	Salt, Lbs per 24 Hours.	Efficiencies Per Cent.	
				Current.	Energy.
Sept. 15–Oct. 11..	2031.5	4.2	217.3	92.7	50.05
Oct. 12–Nov. 22..	2089.3	4.24	218.06	90.4	48.99

The brine in the inner compartment of the cell is maintained at a temperature of 70° C., partly by the current and partly by the transmission of heat from the steam through the diaphragms. The higher current-density now being employed (from 20 to 22 amperes per square foot) is purposely used in order to obtain a greater output of alkali and chlorine from one cell, and this is held to compensate for the slight increase of voltage that may be traced to this cause.

New Lightship For the Delaware Coast.

Light Vessel No. 71, doubtless the best craft of her kind in the world, has left Bath, Me., for the Edgemoor Buoy Depot, situated four miles above Wilmington, where she will be turned over to the Government. Each mast supports three lanterns, and in each lantern is a light hung with ball and socket joints. There is a flashing device on the dynamo bed-plate which causes the lights to burn twelve seconds between intervals of four seconds, thus showing four times per minute. The electric lights can be seen eleven miles away.

CITY OF MEXICO.—A company has just been organized in London, England, under the name of City of Mexico Electric Power Syndicate, Limited, with a capital stock of $25,000 (gold). The object of the new company is to acquire any rights and grants for producing electricity for lighting, motive and other purposes in Mexico, and to carry on the business of electrical engineers and contractors. The directors of the company are R. J. Price, H. K. Baynes and J. F. Toomer. The company will open an office in the city of Mexico in a short time.

ELECTRIC LIGHTING

The Electric Power Plants in Reading, Pa.

BY N. MONROE HOPKINS.

PROMINENT among the many successful enterprises in Reading, a city destined to become one of the great manufacturing and industrial centres of the country, is the combined power plant of the Metropolitan Electric Company, and the United Traction Company, upon which talent and capital have been assiduously and unsparingly applied. From the inception of the company in March, 1883, incorporated as the

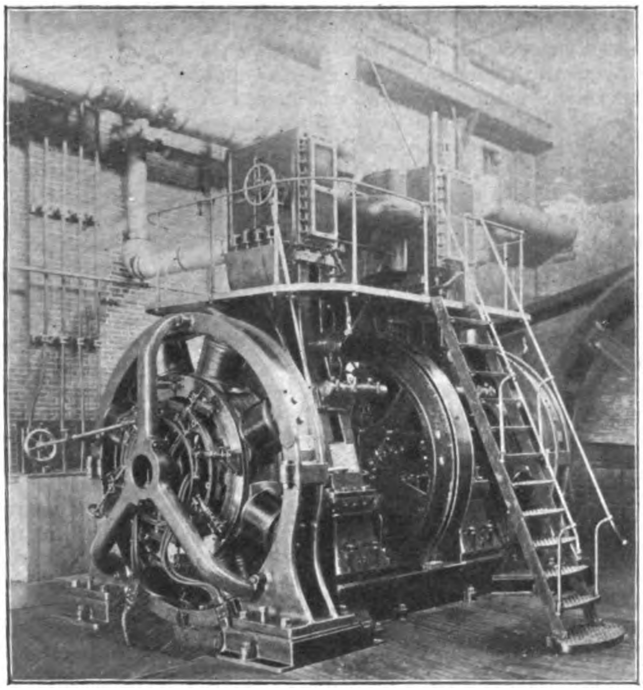


FIG. 1.—INCANDESCENT LIGHTING UNIT.

Reading Electric Light & Power Company, to the present time, the demand for light and power has exceeded the supply, and continues to tax the full output of the station in spite of the fact that it has steadily grown with the city, until it represents one of the largest composite electric plants in operation. With the view of meeting the demands for light, in the suburbs and outskirts of the city, the company has under consideration the installation of a large alternator equipment designed to supply light and power at a great distance. Situated in approximately

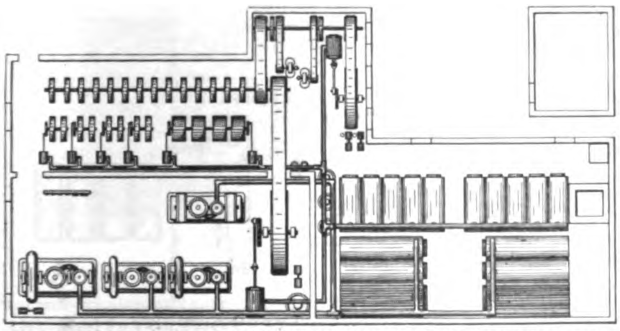


FIG. 2.—GROUND PLAN SHOWING DISTRIBUTION OF BOILERS, ENGINES AND SHAFTING.

the centre of the city, and of the electric railway systems, is the principal steam power equipment, the buildings of which face on Seventh street, between Franklin and Chestnut, convenient to the cars of the Philadelphia & Reading Railroad. From this station nearly 50 miles of electric railroad is dependent for operation, the Reading and Womelsdart line alone being 14 miles in length. Between 15,000 and 20,000 incandescent lamps are maintained, and about 1,000 horse power in motors, located in various establishments where power is required. The arc lights which illuminate Reading's streets are between 500 and 600 in

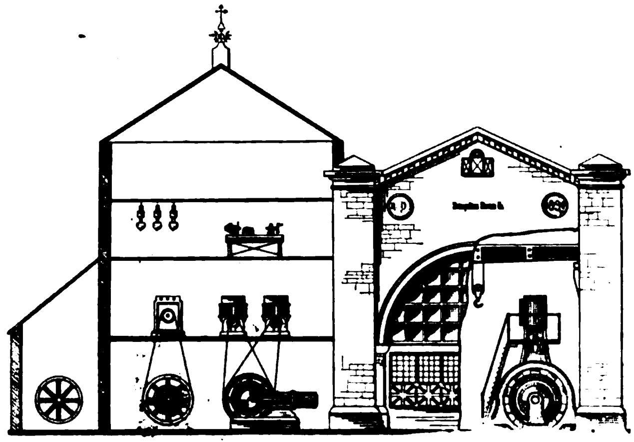


FIG. 3.—SECTIONAL END VIEW, SHOWING OLD AND NEW PORTION OF PLANT.

number, operated from the company's water power plant about three miles below the city on the line of the Reading Railroad. An arc plant of approximately the same capacity is left in reserve at the steam station, having been in service prior to the installation of arc machines at the water power station. It may be of interest before describing the engineering features of these stations, to give a few figures on the cost of light and power in Reading. The arcs are supplied to the city for $105 per year, on a five-year contract. Incandescent lighting is done at the rate of 12 cents per kilowatt, and motors are run for 7½ cents per kilowatt consumption, with a sliding scale of discounts. The earnings of the united plant amount to over $500,000 per annum. The buildings of the Seventh street station are of brick, the new portions having steel girder roofs and concrete floors, being well lighted from above, and allowing ample room for the proper care of the machinery which they cover. A plan view of the Seventh street station can be seen in the second illustration, showing the distribution of the boilers, engines and countershafts, together with the more recently installed direct connected units. The boiler battery is divided into a high and low pressure service, the high pressure steam going to the compound engines of the direct connected units, and the low pressure steam to the

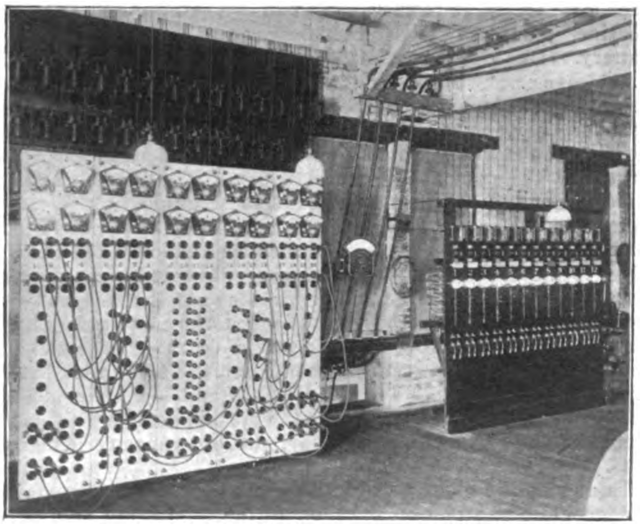


FIG. 4.—BRUSH AND MUNICIPAL SWITCHBOARDS.

high speed belted engines and the simple Corliss. The low pressure battery consists of ten return fire tube boilers of 100 h. p. each, supplying steam at 90 pounds initial pressure. These boilers were built by the Harrisburg Machine & Foundry Co. The high pressure battery consists of six boilers, four of which

are of the return fire tube type, of 150 h. p. each, delivering steam at 150 pounds pressure, built by the Reading Scale & Machine Works, and two "National" water tube boilers of 500 h. p. each, with the same steam pressure of 150 pounds. The piping throughout is of wrought iron, 12 and 14 inches in diameter, 5-16 inch thick, and asbestos covered. No expansion joints are used, the variations in length of the piping being compensated for by means of sweeping copper "ells" at every change of direction. The piping was supplied by Benj. F. Shaw, Wilmington, Del., and the valves by the Fairbank, Pratt & Whit-

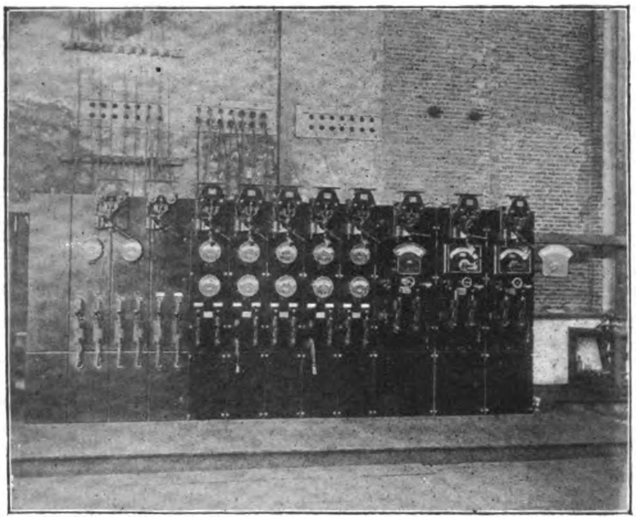


FIG. 5.—RAILWAY AND INCANDESCENT LIGHTING SWITCHBOARD.

ney, and Jenkins Companies. The fuel is anthracite rice coal, mixed with bituminous, one to thirteen, in order to give it life. The price paid for coal by the company is $1.60 per ton, delivered at the boiler house. A brick stack, 125 feet in height, 14 feet square at the base, carries off the products of combustion direct, no economizers being provided. The damper system is that of the Locke Bros., Salem, Mass. The feed water comes from Anteitem Lake and Maiden Creek, and is bought through meters. The combined battery evaporates 2,000,000 gallons of water per month, at a cost of $60. The water from Anteitem Lake contains silica and lime, necessitating the use of boiler precipitating compounds, whereas the water from Maiden Creek contains chiefly vegetable matter. Two horizontal Worthington pumps, each capable of supplying 130 gallons per minute, feed the low pressure battery, and two "Worthington Admiralty Marine" pumps of the same capacity, supply the high pressure battery. This double set of powerful pumps is provided with gate valves, for shutting off the boiler feed, and throwing the supply to fire cocks distributed in efficient places for use in case of emergency. A pressure of 140 pounds may be attained at the nozzles of the hose. This double use of the pumps was introduced by the company's superintendent, Mr. Samuel D. Missimer. Located within a few feet of these pumps is a Westinghouse air compressing equipment, capable of furnishing a continuous blast of air at 75 pounds pressure, which is led through pipes to the dynamo room above, where flexible hose is attached provided with flat nozzles, used for blowing the dirt and dust from the armatures of the various machines. Three large feed water heaters are provided, two being of the "Baragwanath" make, and one of "Berryman" manufacture. The entire battery of boilers is fitted with "Reliance" high and low water alarms. and "Jifferd" injectors. The coal consumption of this boiler plant amounts to 24 tons per day, the bin capacity being 300 tons.

Taking up the older portion of the plant first, with its engines and generators, attention is called to the interesting and rather odd system of countershafts and belts, resultant of a number of changes to the station, and the addition of apparatus. The third illustration accompanying this article, was made to show the ends of these countershafts and their duty on the floor above, together with relation of the new building to the old. Returning to the plan, we find two Corliss engines, directly belted and indirecly belted, respectively, to the long countershaft carrying 14 clutch pulleys. The smaller of these engines, belted to the short intermediate shaft, is of 350 h. p., and is of the Green Corliss type. From this short shaft two 80 k. w., 125 volt, Thomson-Houston incandescent machines are driven, through the medium of clutch wheels. The second Corliss, which is directly belted to the long shaft, is of 700 h. p. capacity, with cylinder 40 by 60, driving a 24 foot wheel, at 60 revolutions per minute. The connection with the countershaft is made by a "Schieren" belt of great weight, which passes through the wall separating the old station from the new, and constitutes a mighty bond between the two sections of the station. The remaining countershafts are independently driven, as shown in the plan, by small high speed engines, revolving the shaft 145 times per minute, against the 285 revolutions of the long shaft driven by the Corliss engines. These high speed engines are of "Ide" manufacture, and are of 150 h. p. each. The friction clutches were made by the Falls Rivet & Machine Co., Cuyahoga Falls, Ohio.

Ascending to the floor above, shown in the sixth illustration, the reserve arc machines and the Edison bipolars are reached. Hand wheels mounted on columns from the floor control the friction clutches below in a most convenient manner. Ten Edison bipolar generators, of 110 volts pressure and 60 k. w. capacity are belted down to the Ide engines, as shown in the third illustration. In addition to these Edison machines, one Edison municipal bipolar generator is installed, wound for 1,200 volts, supplying 500 series lamps for street lighting. It is interesting to note that the switchboard for this municipal machine was originally a 12 circuit arc board, and obtained a first prize at the Philadelphia Electrical Exhibition in 1884. This old board is of slate, and measures 8 by 10 feet, and was reconstructed to meet the requirements of the municipal system, by Mr. Clarence C. Long, the companies' electrical engineer. At present the old board mounts 12 pilot lamps, 12 series of resistances, 12 ammeters, 24 switches and 24 fuses, meeting admirably the conditions for which Mr. Long planned. The ten Edison bipolars of ordinary pattern have their switchboard and controllers in the centre of the group, and are connected on the three-wire system. The arc machines are belted down through the floor to the long countershaft, and are 13 in number. Eleven of these are of "Wood" manufacture, five of 60 light capacity and six of 35 light, the remaining pair being 50 light of Thomson-Houston design. The arc board is of white marble, and is shown in the fourth illustration, with the historical municipal board at the right. This arc board measures 8 by 10 feet, and was built by the Brush Electric Co., according to specifications of Mr. Long. This board has an independent ammeter for each and every circuit, and is protected by 40 Thomson-Houston lighting arresters, located above the board, and shown in the illustration.

The new portion of the station contains the large lighting and railway units, the 3,500 light machine being the first shown in illustration, and the three railway units in the seventh. Two of these railway machines are of 400 k. w. capacity, and one of 800 k. w. These engines are all of the compound type, and were built by the Lake Erie Engineering Co., and are keyed to multipolar railway generators of General Electric manufacture. The frames of these engines are of substantial, heavy duty design, and mount six bearings for each unit, one on either side of each crank, one on either side of the

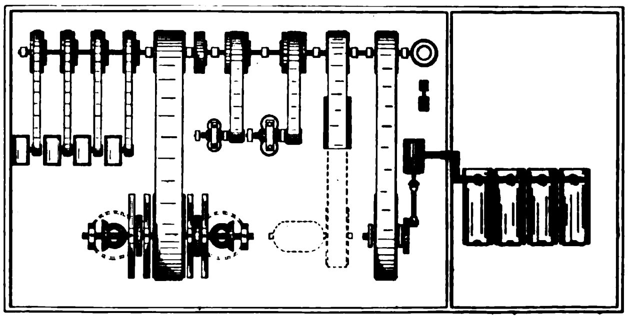


FIG. 8.—PLAN OF COMPANY'S WATER POWER STATION, THREE MILES BELOW READING.
(Showing Auxiliary Steam Plant.)

fly wheel, and one on either side of the generator's armature. The bearings are all water capped, the water being circulated by a Worthington pump, with a capacity of 25 gallons of water per minute. The largest unit has cylinders 22 by 44, with a 36

inch stroke, the normal number of revolutions being 115 per minute. The generators of these engines are wound for 550 volts, but owing to the length of one of the electric roads, the Reading and Womelsdart, through necessity fed from one end, the engines are speeded up until the generators supply the current at 575 volts. The foundation for the largest unit consists of 50,000 hard burned bricks, thoroughly grouted in cement, resting on 18 inches of solid concrete, and capped with an additional six inches of concrete. The two smaller units have the same kind of bed, but made from 35,000 bricks. The fly wheel on the 800 k. w. is 18 feet in diameter, weighs 22 tons, and is mounted on a shaft 18 inches in diameter. All three units are arranged for multiple connection, in response to the demands of heavy traffic due to additional cars, or heavy snow. The lighting unit delivers current at 135 volts pressure, when run at 175 revolutions. The engine carries a heavy fly wheel between the high and low pressure cylinder, and a 100 k. w. generator on each end of the shaft. These generators have double-faced commutators, insuring great life of the machine without repairs made necessary on account of commutator wear. These engines are all run at the present time non-condensing, the exhaust going into the brick stack. Space is left in this building for an additional couple of these machines. The switchboard, shown in the illustration, Fig. 5, is placed opposite the largest unit on the ground floor of the new building. A 20-ton crane is provided, run by hand by means of hanging chains.

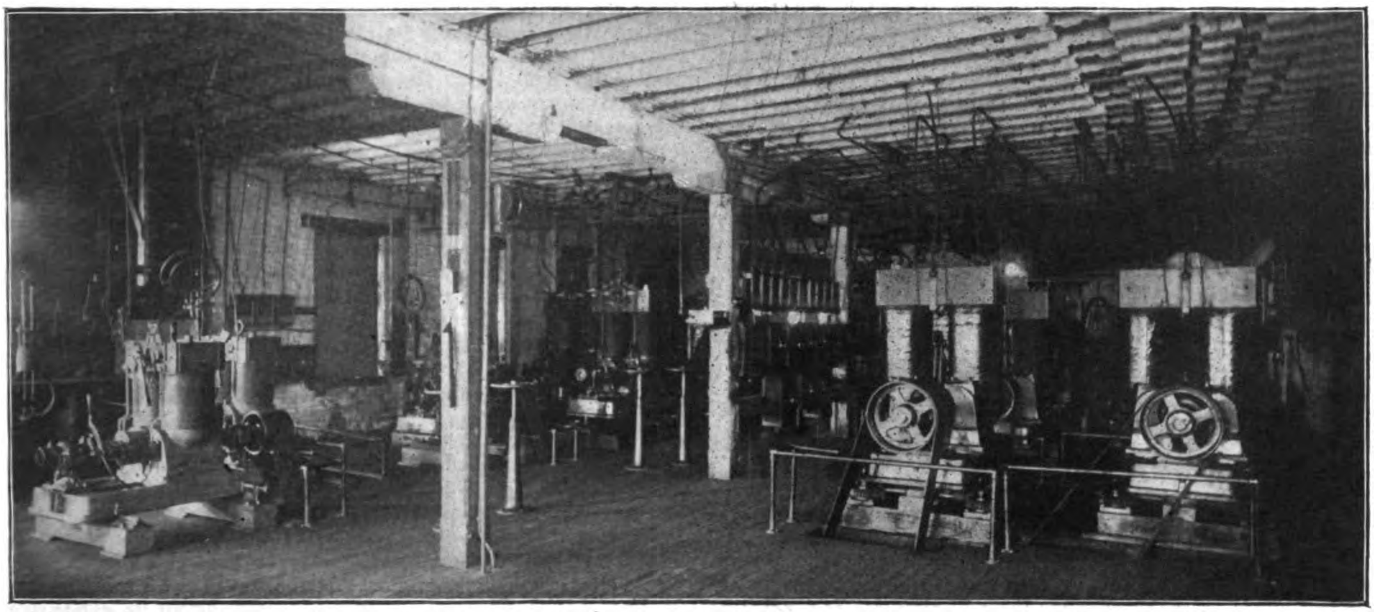


FIG. 6.- RESERVE ARC AND EDISON BIPOLAR MACHINES ON SECOND FLOOR OF OLD PORTION OF PLANT.

The illustration, Fig. 8, is a plan of the company's water plant, known as the "Klapperthal" water power station, although equipped with steam auxiliary, of considerable capacity. The steam portion consists of four 100 h. p. fire tube boilers, built in Reading by the Scott Foundry Co. The engine is a 500 h. p Allis Corliss. The water power is converted into mechanical energy by three wheels. Two of these are upright, 45-inch "Hercules" wheels, acting under an 18 foot head of water, developing 220 h. p. each. They are connected to the large pulley on the main floor as shown in the plan, by means of bevel gears. The third wheel is of "Irwin" manufacture, and is shown under the flooring of the plan in dotted lines. This wheel is

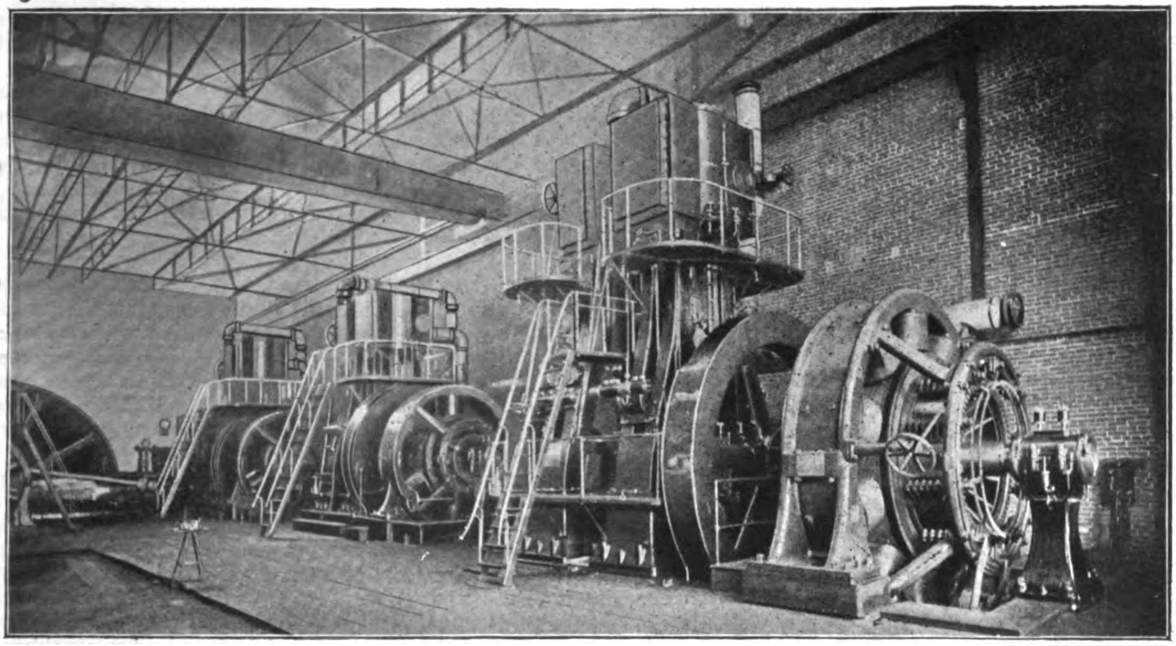


FIG. 7.—RAILWAY GENERATING UNITS.

36 inches in diameter, and develops 250 h. p. The shafting is thoroughly equipped with friction clutches, allowing the instant use of either water or engine power. The generators illustrated in the centre of the plan are 500 volt railway machines, of 200 k. w. and 300 k. w. capacity, respectively. The arc equipment consists of four 125 light Brush machines. The regulation of the water power is effected by the use of electric governors.

The company has for its president, Mr. John A. Rigg, and Mr. K. A. Fichthorn for secretary and treasurer. The directors are Messrs. R. N. Carson, W. R. McIlvain, Geo. H. Valentine, H. C. England, Jas. A. O'Reilly, L. T. Custer, R. L. Jones and R. N. Buckley. Mr. Clarence C. Long is the electrician, and Mr. Samuel D. Missimer superintendent. The writer wishes to express his appreciation of the courtesies and kindness extended to him by Messrs. Long and Missimer, whose thorough familiarity with engineering matters, together with their willingness to furnish data pertaining to the plant which they manage, has been of great assistance in the reporting of this station. Mr. Missimer is well known in Washington, D. C., where, for a number of years, he resided, prior to entering the engineering profession.

The Electric Light Plant in the Small Town—Its Resources and Chances for Extension.

BY J. R. CRAVATH.

I HAVE often seen it stated as an introductory excuse for articles descriptive of electric light plants for small towns that the problems connected with the installation of such plants really required quite a degree of engineering skill and that some little planning was required to get the best results. It is evident that the men who wrote in that way had never been through the trials and tribulations connected with the ownership and management of electric light plants in towns of two to five thousand inhabitants, or they would be aware of the fact that the owners and managers of such plants have more perplexing questions to solve than the officers of the big city companies ever dream of; questions that would be simple enough if the earnings were large and capital readily available for improvements but which under the existing conditions of small earnings are such as to tax the engineering and business ability of the best of men. In this statement I think I have the approval of the several thousand men who are managers and stockholders in plants of the size spoken of.

In this article I do not expect to propose anything radically new. If I did, the manager of the small plant would be justified in reading no further because no small company has any money to spend on experiments. It is simply my idea here to suggest to owners of electric light plants in towns of two to five thousand inhabitants some of the possibilities for increasing business that naturally occur to one who is thoroughly familiar with the conditions existing in many towns of the size mentioned, and who from time to time has been called on to give the matter considerable thought.

A town of the size mentioned usually has an electric light plant, a water works system, a small factory or two, and a dozen or more small steam plants of from one to twenty horse power. Now, there is no good reason why, in the majority of cases, the electric light company cannot supply power to these varied industries cheaper and more satisfactorily than under the present custom of every man for himself. In other words, consolidate the power generation for the community under the roof of the electric light plant; and make the men and boilers and engines there employed earn money twenty-four hours a day instead of two or three. Most men will say in reply to this: "Oh, yes, that's all right for the other fellow, but there's no power business in this town." The writer took occasion to investigate matters once in a town of 4,000 inhabitants, where the manager of the electric light plant expressed similar views. It was found that there were small steam engines in service to the amount of 140 horse power, all dotted around within easy transmission distance of the station. The electric light plant had a maximum winter load of about 175 horse power in arc and incandescent lights. This was not a manufacturing town, but a fair sample of the general run of county seats scattered through the Middle States.

In order to consider this question more intelligently, let us imagine a specific case, taking care that our imagination pictures a set of conditions that prevail in a large number of towns. Take for example a town with a population of 4,500, the heart of a farming district in the Central States. It will have probably a small factory or two, some machine and blacksmith shops, elevators, flour mill, and printing offices, that require power, probably in the aggregate 100 horse power run by small steam engines. The electric light plant if the service is good, the manager energetic and the people are fairly thrifty, will have a load of 40 arc lamps and 120 horse power in incandescents. The incandescents will probably be on the alternating system, and the efficiency of this part of the plant depends very much on the persistency with which the manager has kept small and inefficient transformers off his lines and looked after leaks in insulation on the 1,000-volt primaries. Like every other plant of the kind, it earns money three to four hours a day and loses it the remainder of the time. A few blocks from the electric light plant are the water works, probably owned and operated by the city. Very likely, too, the water supply is taken from a deep well, in which case a most wonderful contrivance known as a deep well steam pump is used. Whatever the supply, it is safe to say that in water works for a town of this size a direct acting steam pump is used. I have never been able to properly appreciate the beauties of the direct acting steam pump except in its smallest sizes; nor have I been able to learn why the designers of the water works plants in our small towns almost invariably put in the most wasteful pumping apparatus they can lay hands on unless it be that they want to give the boiler makers a chance to sell big boilers and the coal dealers a chance to run up as large a yearly bill as possible. The deep well pump found in many small water works is as simple in construction as it is wasteful in operation. The steam piston is directly connected to the pump plunger. Steam is admitted under the piston to raise the load of water and plunger. At the top of the stroke, steam is exhausted at nearly full boiler pressure, and all its expansive power wasted. Two men are employed to run the water works steam plant. Now, it does not require very elaborate reasoning to show that if the electric light plant will put in a power circuit it can afford to bid on pumping the city water by electricity at figures considerably below what the city or water works company can afford to do it for, and that this water works load is a very desirable one for the electric light plant to have; because with the ample standpipe capacity that these water works are provided with, the electric light company can pump the water at whatever hours of the day the light and power load is least and so keep its engines and boilers and men at work on a paying load the whole 24 hours. If the water works have a deep well pump, all that will be necessary to operate it by electric motor will be to counterbalance the weight of the plunger and operate it by a crank geared to an electric motor, and balance wheel. If the supply is not from a well, and direct acting steam pumps are used, it will be necessary to put in double or triple cylinder geared pumps. The steam plant of the water works can be shut down and kept for emergencies, and the two engineers usually hired to keep the water works running can be dispensed with, as all the attendance necessary can be performed by the electric employés.

Taking into consideration the inefficiency of present water works, steam plants and the necessarily high cost of labor per thousand gallons pumped, it is easy to see that there is a chance for the electric light plant to do this work in connection with a power circuit at a fair profit and a reduced cost to the town or water company. It might be said that the electric light plant and water works should on economical grounds be put together in a town of this size, but as the province of this article is to deal with conditions as they usually are, that phase of the question will not be discussed. In most towns they are separate and often the electric light plant is better situated as to coal supply. The important question at issue is how to make the best use of existing plants, as in towns of this size the investment necessary to make any revolutionizing changes is not warranted or at least not forthcoming.

Returning now to our specific case under consideration we find an electric light plant prepared for a maximum load of about 180 horse power. The boiler plant will have, say, three boilers of 75 horse power. The steam engine plant will have probably two engines, both of which are operated to carry the heaviest lighting load, and one of which is run at a very light load from midnight until 6:30 a. m. We have then ample boiler and engine capacity to carry the entire power load of the town for all except about three or four hours in the early part of an evening.

Assuming that there is 100 horse power in small engines in the town, it is not unreasonable to expect that if the rates are low

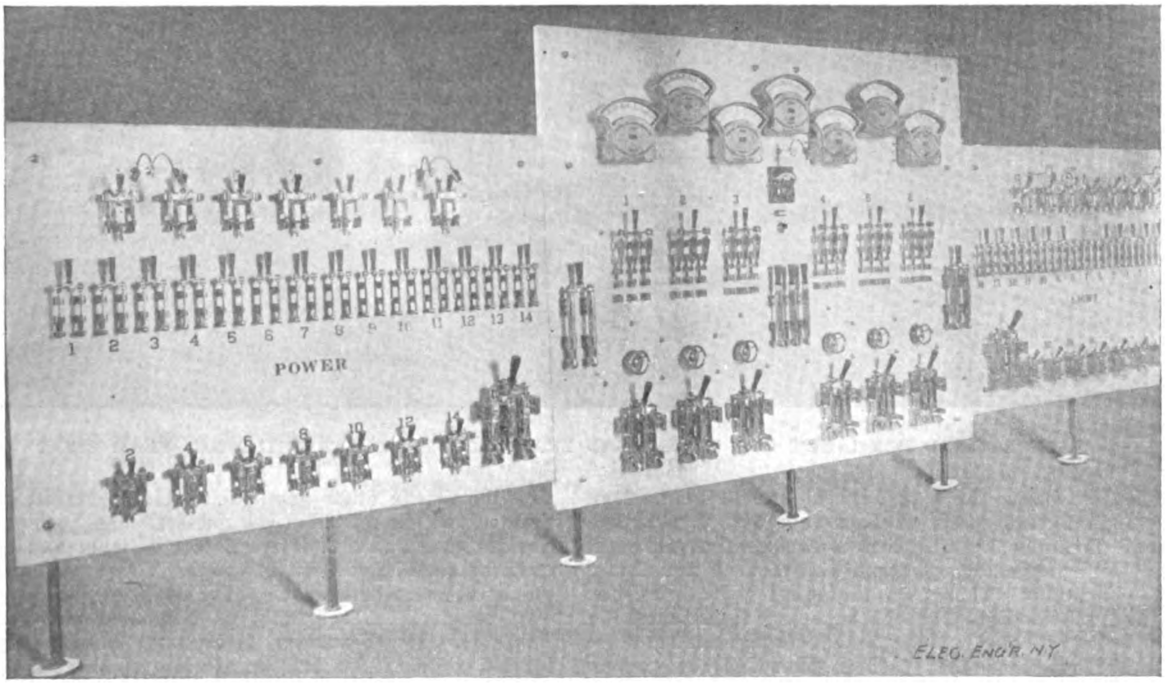
enough, 75 horse power in motor load could be secured, some of which, however, would be intermittent. The securing of the water works pumping work would mean probably 20 to 40 horse power more of power load. The best way to handle this power service would be to put in a 500-volt direct current generator and run a special power circuit around the town. The ideal way might be to put in a two phase alternating system to run power and lights from the same machines and street mains, but this involves the change of all dynamos and transformers, and, as said before, revolutionizing changes cannot be afforded here. Transmission for power at 500 volts direct current involves the least expenditure in such a place, under existing prices, and the service will be practically the same in one case as in the other. The particular arrangement of engines and generators in such a station would necessarily vary with each station, but the general scheme of carrying the load would be somewhat as follows: Going into the plant at noon one would find one engine driving the power generator, the lighting dynamos being out of service. The electric pump at the water works and the other small motors on the power circuit would combine to put a fairly economical load on the engine, probably from 40 to 80 horse power, and one boiler with combustion going on at an economical rate would furnish the steam. When darkness begins to come on, the water works pump can be turned off, and the engine, while continuing to run the power generator for general power supply, has still enough capacity to run an alternator for lighting during the first hour of dusk. At this time the remainder of the machinery in the station will have to be started to take care of the lighting. During the fall and winter, the heaviest load on the plant will be from 5:30 until 6 p. m., when the power load is on and also part of the lights. At 6 o'clock the power generator can be shut down and the boilers and engines made to give their whole output to lighting dynamos, the load on which is a maximum between 6 and 8 o'clock p. m., during December, the heaviest load month. During the evening, as the load falls off, one of the boilers and one of the engines can be shut down, or if necessary the water works pump again started. From midnight until 6 a. m., the time that the plant is operated now at a constant loss, owing to the fact that there is almost no paying load, the engine which drives the alternator can be used to run the power generator to operate the water works pump. At 7 a. m., in the winter the lighting load increases for a brief period, and if necessary the pump can be turned off for a time or more engines and boilers started. From 8 a. m., until noon, the pump and power circuit combine to put a good load on one engine and boiler and still keep the plant earning money.

There is nothing experimental about any of the things proposed. Water works pumps are being operated from electric power circuits and electric light plants are running power circuits. What the writer wishes to emphasize is that in a great many places where electric light companies are doing nothing but lighting, and that at a very small profit, it is possible by combining a power circuit with water works pumping contracts to secure a power load that will considerably increase the earning power of the plant by putting to work machinery and men now employed at a disadvantage because of the few hours per day they are occupied on paying load. There are some places where local conditions will not permit this, but there are many where they will.

There are various engineering details to be thought of in connection with such changes, which I will not discuss here, because each plant presents its own particular problems. Before entering into any such projects the field should be carefully investigated both from a business and from an engineering standpoint. Engineering blunders are usually more serious in small plants in such towns than in large city plants, for in the latter there is possible more reserve machinery and greater earnings to pay for mistakes.

Switchboard for the San Francisco "Examiner" Plant.

THERE is now being installed in the San Francisco Examiner Building in San Francisco, Cal., one of the most complete electric light and power plants in the United States, everything in the building, so far as is possible, being operated by electricity. The accompanying engravings illustrate the switchboard to be used in this installation and we describe it at this time because this switchboard, while intended for use in San Francisco, has been designed and constructed in New York and is now being shipped to San Francisco. In fact, all of the contracts for this plant, with the exception of that for the wiring were taken by local concerns.



SWITCHBOARD FOR LIGHT AND POWER, SAN FRANCISCO EXAMINER BUILDING.—FRONT VIEW.

The board consists of three sections, that on the left being for power, the centre for the generators, and that on the right for lights. It is of polished Italian white marble two inches thick, divided into four panels, one for each end wing and two for the central section. All of the instruments, switches, circuit breakers and other apparatus are mounted directly on the face of the board and, as well as the supporting legs, are finished in polished copper, no nickel or enamel being used, thus giving the board a very rich and finished appearance.

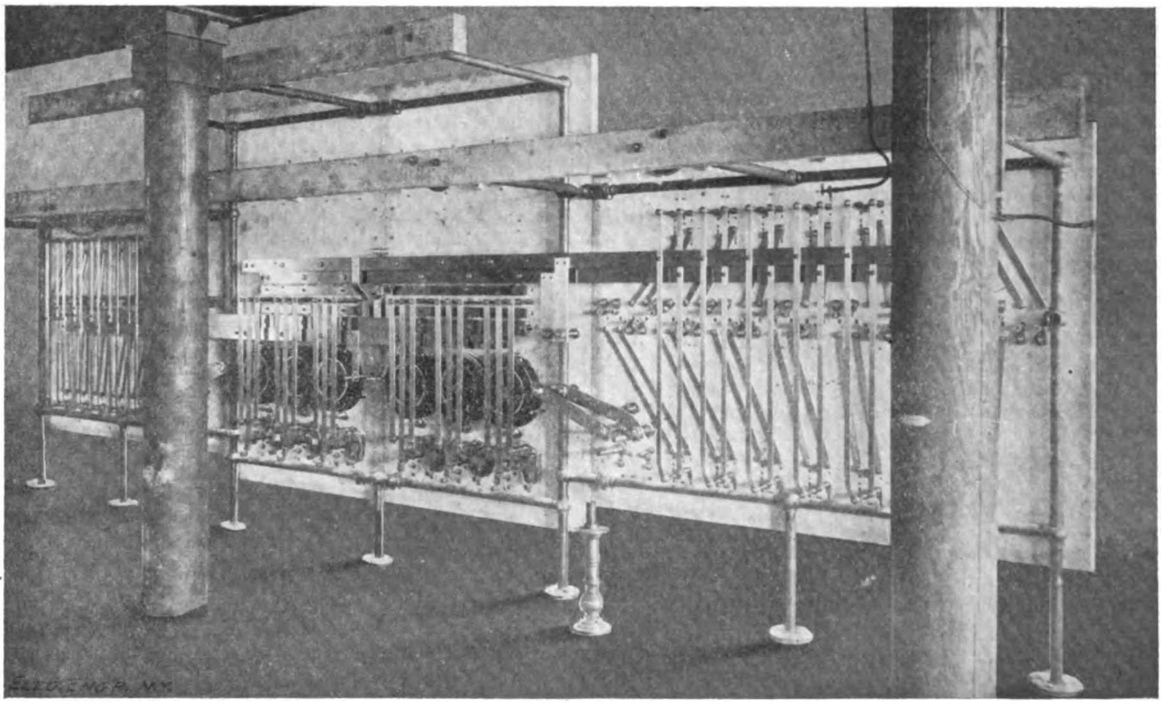
There are fourteen power circuits and fourteen light circuits each controlled by a double jaw double pole Hill switch and a

double pole I. T. E. circuit breaker; no fuses being used upon the board, all circuits being protected by automatic circuit breakers. The power and light circuit breakers are arranged in a double bank above and below the switches and each is numbered to correspond with its appropriate switch. There are two breakdown circuit switches and circuit breakers for connection with separate street service.

On the central section there are six generator circuits each provided with double throw, double pole switches and circuit breakers and one cross connecting switch, so that the power and light busses may be connected together if desired. There are also six handles for controlling the rheostats for the fields of the generators, six ammeters, one voltmeter, one ground detector and one voltmeter switch, all so arranged that the ammeter, main switch, rheostat control and circuit breaker for each generator are in a vertical line one over the other, this avoiding all possible chance for error in manipulation. All of the instruments, switches and circuit breakers are arranged so as to be easily reached by the operator and in such a way that he can operate them with the least possible effort.

The back of the board is finished as perfectly as the front, a noticeable feature being the simplicity of arrangement, there being no complex arrangement of wires and bars crossing one another in all directions, but all being of comparatively straight material and all arranged at right angles to each other and free from all complications. There is a double set of bus-bars, one for power and one for lights, and all necessary interconnecting bars, all of polished copper. The shunts for the ammeter are arranged at the bottom of the board and the field rheostats in the centre. There is also a lighting circuit for illuminating the back of the board.

The whole board is mounted on a supporting frame made of heavy iron pipes united by globe fittings, a construction which is light and strong and admits of great variation in construction. The board is a model of simplicity, practicability and elegance and reflects great credit on its designer, Mr. E. R. Knowles, E. E., who is also the designer and consulting engineer of the Examiner plant, as well as on its constructors, Messrs. Blake and Williams, of this city.



SWITCHBOARD FOR LIGHT AND POWER, SAN FRANCISCO EXAMINER BUILDING.—REAR VIEW.

BOSTON TRAVEL on the suburban steam lines in the last four years is estimated by the State Railroad Board to have decreased about 10 per cent., while the corresponding trolley travel has increased 25 per cent. It runs this way all through New England.

MUNICIPAL AFFAIRS

Municipal Electric Lighting.[1]—III.

BY PROF. JOHN R. COMMONS.

WITH reference to the method of inquiry itself as conducted by the authorities, it must be borne in mind that correspondence and official reports have been mainly relied upon. Mr. Foster, by his own showing, had not personally visited any of the plants concerning which he reports; Mr. Francisco appears to have visited but one of the sixty-four plants tabulated in his pamphlet, and Professor Parsons has apparently visited not more than five or six.

Now, I do not maintain that the correspondence method will fail to give accurate results. It depends upon the care and pertinacity of the investigator. In this respect Professor Parsons excels the other gentlemen. He has taken but little for granted and has made but few guesses. Mr. Foster makes many guesses at the rate of interest, cost of labor and fuel, number of hours burning and candle power. These two writers give the official figures wherever they have obtained them, and then their own estimates subsequently as computed and as printed in Table II. Mr. Francisco gives only occasionally the data for his computations and we are left to infer them from hints vouchsafed here and there. The principal difficulty in the way of securing sound results by correspondence is the impossibility of finding out and weighing the hundred and one local peculiarities which give tone and detail to the enterprise.

These often give a decided turn to the inquiry. Many of them cannot be presented, statistically. For example, the village of Batavia, New York, by providing a council chamber in the building which houses its electrical plant saves $120 in rent each year, equal to $1.20 per arc light. Further, no one can appreciate the sense of relief from the exactions of private corporations and the civic pride and dignity of the citizens who have successfully overcome these exactions unless he visits them, talks with them and learns the history of their movement for municipal ownership.

[1]Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec. Engr.

AGREEMENT AS TO OPERATING EXPENSES.

In attempting to explain the wide discrepancies in these three methods of estimating the cost of municipal lighting we need to divide the cost of production into two parts, operating expenses and fixed charges. Operating expenses are usually stated by the officials of the various cities in the annual reports, and these with the annual output given, make it difficult to arrive at wide discrepancies in estimating the operating costs per lamp.

Table II.
Comparative Estimate of Net Cost to City for Street Lamps—Francisco, Foster, Parsons.

Cities.	Candle Power.	Hours per Year. Francisco.	Hours per Year. Foster.	Cost per lamp hour. Francisco.	Cost per lamp hour. Foster.	Cost per lamp year. Francisco (Computed).	Cost per lamp year. Foster (Computed).	Parsons. Operating Expense.	Parsons. Operating Expense, Interest on Debt, Depreciation 5%.	Computed Interest 4%, and Depreciation 5% on Total Investment.
Alameda, Cal.	2000	..	1420	.1458	.124	..	$178.80	$120.00	..	$162.30
Allegheny, Pa.	2000	4000	..	.0230	..	$92.00	..	64.00	$79.00	..
Arlington, Minn.	1200	1460	2000	.021	.0502	306.60	100.40	40.00	..	56.50
Aurora, Ill. w. w.*	2000	2622	2426	.0447	.0371	117.20	90.37	53.50	61.00	..
Bangor, Me. w. w.	2000	3750	..	.0278	..	104.25	..	34.00	..	54.70
Bay City, Mich	2000	..	2418	.0376	.0308	..	74.47	50.00	60.00	..
Braintree, Mass.	1200	1912	..	.0517	..	98.85	..	47.50	69.50	..
Bloomington, Ill. w. w.	2000	2247	..	.0545	..	122.46	.	50.00	66.50	..
Bowling Green, Ky. w. w.	2000	2190	..	.0498	..	109.04	..	50.00	60.00	..
Chicago, Ill.	2000	..	3950	..	.043	167.78	169.85	96.67	..	152.47
Council Grove, Kas.	1200	1875	2000	.0779	..	146.06	..	O†	..	27.00
Crawfordsville, Ind.	2000	2190	..	.0671	..	146.94	..	25.50	..	41.25
Crete, Neb.	1200	..	1590	..	.0805	..	127.99	O†	..	17.10
Decatur, Ill. w. w.	2000	1460	..	.0752	..	109.79	..	50.00	..	..
Dunkirk, N. Y. w. w.	2000	3000	3915	.0278	.0273	83.40	80.39	46.00	59.25	..
Easton, Pa.	2000	3219	3031	.0445	.0413	143.24	125.80	85.00	103.20	..
Elgin, Ill.	2000	2190	2500	.0546	.04	128.33	100.00	43.00	55.50	..
Fairfield, Ia. w. w.	2000	2190	1680	.07	.0765	153.30	128.57	70.00	85.50	..
Farmville, Va	2000	..	2160	..	.0424	....	91.58	840.00†	..	..
Frederick, Md.	2000	2190	2160	.0435	.0394	93.26	85.10	54.00	65.50	..
Fredonia, N. Y.	2000	1460	.	.0524	..	76.50	..	48.50	58.50	..
Galion, Ohio	2000	2190	..	.0511	..	111.90	..	40.00	..	66.15
Galveston, Tex.	2000	2190	2700	.0557	.0318	121.98	85.86	70.00	..	85.30
Goshen, Ind. w. w.	2000	2190	2168	.0513	.0480	112.34	104.64	68.00	81.75	..
Hannibal, Mo.	2000	2150	2190	.0540	.0271	134.30	59.34	..	..	..
Hudson, Wis.	1200	..	2208	..	.0221	..	48.76	36.00	42.00	..
Jamestown, N. Y.	1200	2190	..	.0577	..	126.36	..	21.50	32.00	..
Lewiston, Me. w. w.	2000	3000	2785	.0291	.0257	87.30	71.51	43.00	..	57.40
Little Rock, Ark.	2000	..	2168	..	.0503	..	109.05	42.00	50.0	..
Luverne, Minn.	2000	..	1815	..	.0254	..	46.10	520.00	..	..
Marietta, Ohio w. w.	2000	2190	..	.0589	.05	97.31	..	83.75	42.00	..
Marshalltown, Ia. w. w.	2000	1460	1950	.0335	.0226	48.91	44.07	18.50	27.50	..
Martinsville, Ind. w. w.	2000	1460	..	.0464	..	67.74	33.00	41.33	..	..
Metropolis, Ill. w. w.	2000	2190	1453	.0435	..	95.26	..	27.50†	..	33.80
Miamisburg, O.	2000	2190	..	.0434	..	95.04	..	52.00	..	60.00
North East Pa.	2000	1875	..	.0368	..	72.39	..	50.00	53.33	..
Painesville, Ohio	2000	1875	1838	.0390	..	73.12	72.60	44.25	53.50	..
Paris, Ill. w. w.	2000	1875	.	.0523	..	97.06	..	40.00	45.50	..
Portsmouth, Ohio. w. w.	2000	2190	..	.0481	..	117.33	..	39.00	49.00	..
Shelby, Ohio	2000	2190	..	.0562	..	123.16	..	56.00	..	71.30
Savannah, Mo	1200	1460	..	.10	..	146.00	..	O†	..	14.85
Statesville N. C.	2000	1875	..	.0355	..	66.56	..	40.00	..	53.50
St. Clairsville, Ohio	2000	3750	2282	.0269	.0233	100.87	52.94	28.00	..	53.50
St. Peters Minn. w. w.	2000	1460	..	.0757	..	110.52	..	O†	..	7.20
S. Norwalk, Conn.	1500	..	2255	..	.0385	90.89	63.86	42.33	61.00	..
Topeka, Kas.	2000	2500	.0430	..	..	107.56	74.00	87.00	..	..
West Troy, N. Y.	2000	3750	3950	.0306	.0241	114.75	95.19	61.00	75.00	..
Ypsilanti, Mich. w. w.	2000	1460	..	.0661	..	96.94	..	36.00	..	54.49

* Electric works operated in connection with water works
† Profit on entire plant.

This is evidenced in Table I., where the labor costs as given by Parsons and Foster are set side by side. In this item, as well as fuel, repairs and supplies, there is but little opportunity to go behind the returns unless one actually visits the plant and carefully compares item by item the labor, fuel, repairs and supplies actually consumed with that which enters into the published reports. Consequently, we find these two authorities closely agreeing on operating expenses as will be further seen in Table III.

TABLE III.
COMPARATIVE ESTIMATES OF OPERATING EXPENSES PER ARC LAMP.

	Foster.	Parsons.
Chicago, Ill.	96.50	96.50
Easton, Pa.	82.44	85.33
W. Troy (Watervliet), N. Y.	61.22	61.00
Dunkirk, N. Y.	47.28	46.00
Goshen, Ind.	67.85	68.00
Plainesville, O.	49.42	52.50
Little Rock, Ark.	68.50[1]	42.00[1]
Aurora, Ill.	57.59	53.50
Fairfield, Iowa	70.39	70.00

Mr. Francisco is an exception to this agreemnet. He vigorously attacks the published reports and discovers malicious attempts to transfer accounts, to misrepresent operating expenses and repairs as new construction, to charge electric light to other departments, and generally to bolster up a rotten business for the benefit of nobody but the politicians. I am unable to follow him in all his figures, as I have not been able to visit the plants whose accounts he criticises. But such evidence as I have been able to get seems to show that he is the wildest sort of a Don Quixote.

Mr. Francisco has also a sliding scale for depreciation. Where he thinks the operating expenses and interest charges of a municipal plant are high and do not need much inflation Mr. Francisco calculates depreciation at five per cent. as in Braintree and Swanton. But when expenses are low and a great cause is at stake, depreciation rises to eight per cent., and so South Norwalk, Detroit and many other places are saved. I mention only those places where he himself states the rate of depreciation. In other cases I am led to infer that it vibrates up and down usually near the eight per cent. pole, by comparing his figures with those of Mr. Foster, who uniformly estimates depreciation at seven and one-half per cent.

Perhaps too much space has been given to Mr. Francisco, but the space seems justified in view of the fact that he is quoted extensively by all who oppose municipal ownership. But the method adopted by Mr. Francisco of comparing the relative efficiency of the two systems on the basis of the candle power per hour furnished for one cent is vitiated by his reckless charges for depreciation and his liberties with the financial reports on operating expenses, as a comparison with Mr. Foster's figures shows in Table II.

BETTER QUALITY OF MUNICIPAL LIGHTING.

It is also to be remembered that there are two qualifications necessary before we can know that the candle power is relatively as great as it appears. These are the quality of the light and the "outages." In every municipal plant, almost without exception, the people of the locality are found on personal inquiry to speak in enthusiastic terms of the superior quality of light they are getting. Unfortunately this field of electric lighting has not been adequately tested, and but few cities, either with public or with private plants, have any record of photometric tests of the efficiency of their lights. The candle power is the "nominal" 2,000 candle power of French standard, which Slingo & Brooker[1] estimate as giving actually only 875 candle power when the current is ten amperes and the voltage fifty, so that this amount of light is produced at a cost of 500 watts. As the usual power varies from 425 to 475 watts per lamp, and municipal officials never as far as I know are provided with photometric appliances, it is within the power of private companies to diminish the candle power below the standard required in their contracts. As long as exact measurements are lacking, we are compelled to depend upon the common opinion of the locality, which is indeed not an accurate judge. This general satisfaction of citizens in their light is one of those local factors which statistics cannot present, but which go far in determining the preference for municipal plants. Dunkirk is given by Francisco as furnishing 718 candle power per hour for one cent, but taking into account the fact that the dynamos there are run at eighteen amperes, and 520 watts are delivered to each lamp, and that the general impressions of citizens and visitors unite in describing them as the brightest lights to be found anywhere in street lighting, it is evident that, in addition to his juggling with costs, his estimate of quality also does injustice to the plant.

[1]Foster gives 132 arcs; Parsons, 210.

LA TEORIA DEI RAGGI ROENTGEN. By Prof. Filippo Re. Palermo, 1898. Alberto Rebers. 64 pages. 6 x 8½ inches. Paper. Price, 60 cents.

The author has undertaken a critical discussion of the various theories propounded to explain the phenomena of the Röntgen rays. This is not intended as a complete or even partial record of work in X-ray experimentation, but the sources of information given by the author supply this purposed omission.

MR. H. B. COX is the subject of an illustrated biographical page article in the March issue of Success. It might be better done, as it is hardly just to Mr. Cox's work and aims, but the matter and cuts are interesting as far as they go.

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Vol. XXV. NEW YORK, MARCH 10, 1898. No. 514.

"Made in America."

IN a letter addressed to the "Iron Trade Review," Mr. Andrew Carnegie in a brief but convincing manner shows that a shipyard built in or near New York Harbor and properly equipped and managed ought to be able to compete with any similar establishment in any part of the world. As Mr. Carnegie points out, we can produce steel more than 25 per cent. cheaper than at Glasgow, for example, while as to cost of labor, the most modern appliances, even at higher rates of labor existing here, would reduce this item below that prevailing abroad. Mr. Carnegie is anything but a dreamer, and if confirmation of his proposition be desired, the electrical arts will furnish an excellent example. As to American electric railway apparatus in Europe, that has taken so firm a position that it will be difficult to dislodge our products permanently, if at all, in the future. It may be urged that our experience in electric railway work gave us an advantage of which we have reaped the benefit. Granted for the sake of argument. But how does this explain the continued and increasing shipment of dynamos and motors, circuit breakers, etc., to Europe from our shores? Only recently we were permitted to glance at a list of foreign orders in the works of one of our well known manufacturers,—a list covering page after page of various types of machines and apparatus. But what struck us most was the fact that the machines ordered were not merely for fan motors and the smaller sizes, but ranged all the way up to 60 h. p.! We must confess that the showing surprised us. The meaning of it appears plain when one considers first, the cheapness of our raw material, iron and copper, and secondly the perfection of methods of manufacture, in which machine work is the dominant factor. That this is probably the true solution of the question finds further confirmation in the fact that an able American electrical engineer will shortly leave for Germany to design a line of dynamo electric machinery for a firm in that country, on the American system of manufacture. Reduced to a plain proposition, Europe is still building dynamos, while we have long since manufactured them. We believe that the lead taken by America in this respect will be maintained for a long time to come, while on the other hand, our cheaper raw materials will always give us an advantage which ought to be of a lasting nature.

Mr. O. B. Shallenberger's Work.

COMPARATIVELY few of the large number of electrical engineers and workers now engaged in the electrical field can recall vividly the exact condition of affairs and the state of the art as it existed but a dozen years ago. Up to that period the direct current had held undisputed sway; its main problems had been practically worked out and what improvements have since been introduced have been mostly matters of detail, albeit many of these have left a marked impress on the art. But with the introduction of alternating current work in the United States, there dawned a new era of development entirely distinct in many respects from that which had preceded it. We need hardly recall the bitter controversies and discussions carried on under the generic head of "Direct vs. Alternating Current," which were waged with great energy on the part of the respective adherents of the two causes,—controversies, indeed, the echoes of which are still heard from time to time, though growing fainter at each reverberation. One of the greatest objections urged at the time against the alternating current was the absence of a meter to record the consumption of current. This was, in truth, a serious objection as even at that time the flat rate basis of charge was recognized to be a make-shift arrangement conducive to waste of current, and open to other not less serious fault finding. The demand for an alternating current meter was urgent, and indeed it may be said that its practical accomplishment was of paramount importance to the success of the alternating current industry. We believe that the honor and credit for the first successful meter of this type will be generally conceded to belong to the late Mr. O. B. Shallenberger. Seizing upon a phenomenon accidentally observed, he made it the basis of one of the most beautiful as well as one of the most accurate instruments known in the field of existing electrical measuring apparatus. The record of Mr. Shallenberger's work, the salient features of which are given on another page, proves him to have been a high type of the American inventor, and one who beautified everything he touched. The mere fact that after ten years of practical use the Shallenberger meter of to-day is practically the same instrument that it was when introduced is proof sufficient of its inventor's thorough grasp of principles and their industrial application. "Si monumentum quaeris, circumspice," was never more truly applied than to the inventor just gone from among us. His memory will always live in the annals of electrical work as a pioneer of true genius, one who by his sunny nature and imaginative turn of mind always suggested to those who knew him intimately that relationship between true poet and true inventor which lies under the surface of mere worldly and commercial considerations. The data now presented is but one leaf out of the life book of one who died all too young and all too soon. We desire to acknowledge our indebtedness for this material to the Westinghouse Electric Manufacturing Company, which has hastened to contribute to our columns this memorial of a career spent so loyally and brilliantly in its service.

The Single Phase Induction Motor.

THE polyphase induction motor has met with such rapid introduction in commercial practice, due to the success of long distance transmissions, that it has rather crowded into the background its single phase prototype. We do not propose here to enter upon a discussion of the relative merits of these two types, merely recording the prevailing opinion of those entitled to speak with authority, that the polyphase motor possesses advantages distinctly its own. But the fact that single phase stations constitute as yet the large majority of the work-

ing installations both here and abroad and bid fair to continue as such for an indefinite period in the future, makes it eminently desirable to bring to as high a state of perfection as possible motors adapted for the current furnished by them. For this reason, if for no other, the able and scholarly paper read by Mr. C. P. Steinmetz before the American Institute of Electrical Engineers, on February 23, will be welcomed by all who still regard with hope the future of the single phase motor.

The first portion of Mr. Steinmetz's paper deals with the load and speed curves of the single phase induction motor, and tells us that the motor will not start from rest, but when started in either direction will accelerate with increasing torque and approach to synchronism; that the speed is much more constant in the single phase induction motor than in the polyphase motor. Also that the maximum torque and output of the single phase motor are somewhat greater than those of the three-phase motor per circuit. The second portion deals with single phase induction motor starting devices; and all the methods devised for this purpose are divided into three classes, namely: 1. Phase splitting devices; 2. Inductive devices; and 3. Monocyclic starting devices. These three methods are then discussed in detail and undergo a thorough mathematical treatment, emerging at last with a verdict in favor of the last named, which most nearly reproduces in starting and accelerating the conditions of the polyphase motor.

Unfortunately the paper was but briefly discussed by a number of experts, who seemed to agree, that even admitting the saving of wire attending the use of the single phase induction motor, as well as its high efficiency and no-sparking quality, the low power factor and difficulty of regulation of the motor will prevent it from superseding the polyphase motor in the near future. Mr. Steinmetz's mastery of the subject is unquestioned, and his thorough investigations and exhaustive presentation of this difficult problem entitle him to the gratitude of the profession, but it appears that the subject is sadly in need of a Faradic treatment before it can be brought within the reach of the mental faculties of the average electrical engineer of to-day. But as in the case of the direct current motor, time will serve to crystallize and clarify the theories which now seem so involved to many.

An Electrical Corps for Our Army and Navy.

THE recent organization of the Corps of Electrical Engineers in England and the activity in our own army and navy circles subsequent to the terrible disaster to the Maine has reminded us forcibly of the lack of electrical training of our militia, and recalls the timely warning of Lieut. B. A. Fiske, U. S. N., who over seven years ago advocated the formation of an electrical corps. There is an old German proverb which says that "After the child has fallen into the well they think about covering it up," and similarly finding ourselves ill prepared for a sudden emergency, people are now urging the formation of the much needed electrical corps. Lieut. Fiske in his very able address before the New York Electrical Society in 1890, on "The Civilian Electrician in Modern War," showed by giving a résumé of the manifold uses of the electric current on warships and in fortifications, that electricity has come into use as one of the great factors in warfare, both on sea and shore, not as an adjunct, such as for lighting ships and forts, but as a vital element in the handling of weapons in actual battle and in the construction of new instruments which accomplish things heretofore impossible. Such a corps, he held, could be formed under existing laws, and there would be no difficulty in enlisting members. The qualifications as regards education and intelligence would be greater than those for any other regiment, corps or battalion. Its military and naval usefulness would be acknowledged, and its position in all respects would be one of dignity. The whole electrical influence of New York and of the country would be at its back, and there is no reason why it should not acquire a worthy national fame. We strongly recommend the immediate formation of such a corps of electrically trained army and navy engineers, who would be of invaluable service to our country in time of war. An ounce of prevention is better than a pound of cure.

In this connection our little article on the electrical equipment of the Maine will be of interest. It sums up the work done on shipboard, and shows how large a factor electricity is. Very few uses of electricity are overlooked. Yet strange enough, as was pointed out the other day, thermostats are not included, and we are informed that the hand thermometer prevails. It will be noted that electrical conductors are not run near the magazines.

Telephone "Extortion."

AT the present moment there is a "crusade" in Washington, just as there is in New York, against the local telephone company, by certain persons, but it is based on grounds which are more or less ill chosen. For example, a Dr. R. Kingsman complains of treatment in the Washington "Star" and tells his case. He had a patient whose condition alarmed him, so that he rushed to the nearest telephone station, where, not being known, he informed the operator who he was. Having no small change he could not drop his ten cents in the slot and "was forced to stop long enough to get a bill changed. The latter was the most annoying part as the circumstances were desperate." The doctor asks us to imagine his feelings, and to judge the company accordingly. How foolish! We can all imagine his feelings, but why think harsh things of the innocent company or its operator? The doctor might be in a hurry to take a car or mail a letter, or hire a messenger, but he would have to split his ten dollar bill or his gold coin, and he alone would be to blame for not providing himself with small pieces of money. If he were to try large bills on the New York elevated or street cars, he would run great risk of being bounced, whether the city or private company owned the roads. His deficiency of small coin at a critical moment was very unfortunate, but proves nothing against any company. It is surprising, on the contrary, that such a puerile complaint should come from an educated, professional man. His story reminds us of the doctor out in one of the middle States, who owns some telephone lines of his own and who will not allow any other medical man to use them for professional calls. We hardly know which is the more unreasonable of the two men.

A Novel Convention Plan.

ONE of the most interesting and attractive plans we have ever seen suggested for a convention is that of Mr. J. M. Hill, of Chicago, in behalf of the Northwestern Electrical Association. The idea is to hold the convention on one of the fine steamers plying between Chicago and Duluth, two or three days being spent thus on Lake Superior, and the remainder of the week at Duluth, points of interest being taken in on the way, such as Sault Ste. Marie, the Calumet and Hecla copper mines, Mackinac, etc. It will be remembered that the National Electric Light Association is to meet in Chicago, June 7, 8 and 9; and at the end of that week Mr. Hill proposes that ship shall be taken for Duluth, filling in a second week. A warm welcome awaits at Duluth, and there is, of course, much of interest to be seen there and at the City of Superior.

This is a bold scheme, with attractive features, and if the lakes are calm it ought to be a delightful trip. Probably some of our readers will hardly care to indulge in the three weeks' absence from home and business that it involves, but others may be glad to avail themselves of such an opportunity for seeing the Great Northwest at the beginning of another era of prosperity. Mr. Hill proposes that the beautiful steamer "Northwest" shall be engaged forthwith, and that half-a-dozen notable electricians shall be invited as guests. There is nothing half-way or half-hearted about his plan, and if it is carried out, successful excursion convention methods will have been notably increased.

TELEPHONY AND TELEGRAPHY

The New Telephone Exchange Building, Brooklyn, N. Y.

THE New York and New Jersey Telephone Company enter this month upon the occupancy of their handsome new building, corner of Willoughby and Lawrence, Brooklyn, a most central location. For the present the central exchange will not be transferred, but the offices will at once be concentrated in the new headquarters. When the conditions and preparations are ripe, the exchange transfer will also be made. This new building, one of the finest in the Borough of Brooklyn, is eight stories and basement: The first and second stories are of dark blue Indiana limestone, thence upward the constituent masonry is of pearl gray brick and terra cotta. The building is of the strongest material. The inner foundation supports are massive blocks of heavy concrete, upon which rest systems of heavy iron beams, constituting a grillage base, sustaining steel posts, extending to the roof. The floor construction is divided to best advantage beween hollow, fireproof flat arches and the Columbian fireproof system. Throughout, the interior building work is of the modern steel frame construction.

The most modern plumbing and heating methods go to the

NEW EXCHANGE OF THE NEW YORK AND NEW JERSEY TELEPHONE COMPANY.

equipment, and the protection against destructive conflagration guaranteed by the structural materials is supplemented by effective fire-fighting apparatus, including two hydrants within reach of the fire department, with water capacity for over-reaching not only the roof of the telephone building itself, but the roofs of other buildings within a block of it in any direction.

On the first floor of the buliding will be the supply department, on the second, the repair shop, while on the fourth will be the office of the general superintendent; on the fifth that of the general manager; on the sixth, the office of the treasurer; on the seventh, that of the auditor, while the eighth floor will be the operating room, where there will be one of the largest switchboards in the country.

The New York and New Jersey Telephone Company, whose charter covers Long Island, Staten Island and the northern half of New Jersey, when organized in 1883, and for five years thereafter, had its offices at 397 Fulton street, but since 1888 they have been at 16 Smith street. In its first year, it had thirty central exchanges, and 2,339 subscribers all told, 1,656 of whom were in Brooklyn. At the present time the company has thirteen exchanges in Brooklyn, 18,500 subscribers on Long Island, eighty-six central offices, and a service in every town and village throughout the Island. The service places the subscriber in connection with 40,000 stations in and around Brooklyn and 200,000 throughout the United States.

The New York and New Jersey Telephone Company, which stands in the forefront among the telephone enterprises of this country by reason of the magnitude of its operations, may congratulate itself upon its achievement, not only for what it has done for its subscribers, in giving them an admirable service, but also on the splendid structure it has reared, which may be said to properly represent the character of the enterprise.

The officers of the company are: President, Charles F. Cutler; vice-president and general manager, W. D. Sargent; secretary, Joel C. Clark; treasurer, Henry Sanger Snow; executive committee, Charles F. Cutler, W. D. Sargent, Joseph P. Davis and Joel C. Clark. The board of directors consists of Charles F. Cutler, Alexander Cameron, Joseph P. Davis, Charles A. Nichols, Hugh Kinnard, William D. Sargent, David B. Powell, George H. Prentiss, Joel C. Clark, Felix Campbell, Edward J. Hall and Henry Sanger Snow.

The Telephone Business In Cincinnati.

The annual report of General Manager G. N. Stone of the Cincinnati Telephone Co. shows what work has been accomplished by the company during the past year, and also gives some statistics of considerable interest. No service, except possibly that rendered by the United States Postal Department, which was operated at a loss to the Government, of $8,127,088.44 in 1896, and $11,411,779.65 in 1897, approximates in convenience and cheapness that represented by the business handled by this company, at an average cost to its patrons of only a fraction less than one cent per message, including answers thereto. Many of the subscribers use their telephones more than one hundred times per day, which reduces the cost to them to so small a fraction of one cent per message that it cannot be estimated. The company's business has been highly satisfactory. Many extensions and additions have been made and many new exchange subscribers gained. Toll lines have been extended, local pole lines reconstructed, and underground subways extended.

Making a comparison with the number of exchange subscribers, it is found that within the past ten years the list of subscribers has increased from 3,110 to 5,281. Of the entire number of exchange subscribers 4,285 are connected by copper metallic circuits, equipped with long distance instruments. The record of exchange messages kept during the past year shows the company has made for its exchange subscribers within the Cincinnati exchange district 25,510,752 connections, or an average of 17 calls per day per subscriber. This company now has 258 miles of poles and 1,238 miles of wire in use in its toll line system in the States of Ohio, Indiana and Kentucky. The number of toll and extra-territorial messages handled during the year 1897 was 160,504; during the year 1896 was 140,973, an increase of 19,531. Average number of toll messages per day, 440. The total mileage of wires is 6,910 miles and 490 poles. There are 299,310 feet of underground cable, containing 5,353 miles of conductors in pairs.

Government Telephony For Washington Public Buildings.

In the U. S. Senate at Washington on March 3, Mr. Butler (Pop., N. C.,) introduced an amendment to the District of Columbia Appropriation bill, appropriating $100,000 to be used by the Postmaster General to establish and equip a modern telephone system among the public offices and buildings in the district. The idea is to have a complete exchange system for the public departments, quite independent, it is said, of the regular Bell exchange now serving the district.

Hearing the Children's Prayers By Telephone.

During the early part of a dinner recently given in Washington, the guest of honor, a young married woman who is the proud mother of two very small boys, suddenly paused, with a startled look, in the midst of an animated conversation with her host, and cried: "There, if I didn't forget those boys again! Have you a telephone in the house, and may I use it?" Her host conducted her to the telephone, and presently she returned.

"I do hope you will pardon me," she said; "but you see, I always have Georgie and Eddie say their prayers to me before they go to sleep. In the hurry of getting off, I forgot it tonight, so I have just called up their nurse. She brought the children to the telephone, and they have just said their prayers over the wire, so my mind is relieved."—Argonaut.

Bell Telephone Output.

The American Bell Telephone Company's monthly statement of output of instruments for the month ended Feb. 20 shows:

	1898.	1897.		
Gross output	25,897	19,680	Inc.	6,217
Returned	12,790	8,015	Inc.	4,775
Net output	13,107	11,665	Inc.	1,442
From Dec. 21 to Feb. 20:				
Gross output	51,758	34,117	Inc.	17,641
Net output	28,927	19,701	Inc.	9,226
Outstanding	949,620	791,990	Inc.	157,630

SOUTHERN BELL TELEPHONE COMPANY has recognized in a substantial manner the fidelity of its employés who stood by the posts during the recent yellow fever epidemic.

An Artesian Lighting and Power Plant.

FRED. DONALDSON, YANKTON, S. D.

SIX years ago I decided to sink an artesian well upon my premises for the purpose of grinding feed, sawing wood, ripping lumber, etc., and after it was completed, I found I had power enough to operate a small dynamo. The artesian power being a steady power I did not need the regular appliances used with the dynamo, but simply a voltmeter. I run thirty-five lights with my machine, which light my residence, barn, and place of business, and all this after the machinery was installed costs me about 20 cents a month for electric lights; this cost is for oil.

A few months ago I decided to build a grain elevator, and in this I also placed an electric motor, which furnishes the power to run the elevator and grain cleaning appliances. I run my machinery by the artesian well. The diameter of the pipe is 4½ inches and is 525 feet deep. I have hydrants about my premises and in case of fire, I have 200 feet of 2½-inch hose and I can throw water in a solid stream 100 feet. The power is derived from an undershot water wheel. All I have to do when I want to run my elevator, electric lights, or any of my machinery is to turn a wheel which controls the water, and away she goes. I may add that the dynamo and motor were built by the Sioux City Electrical Company, and have always worked admirably.

Electricity For Turret Turning On American Men-of-War.

IN view of the recent attention directed to naval affairs, it is interesting to note the great superiority which electricity gives over steam, pneumatic and hydraulic power for the extremely important service of turning and controlling the turrets on the battleships which carry with them the guns. A severe comparative test of the steam controlled turret and the electrically controlled turret was made upon the Brooklyn in 1896 by a committee appointed for the purpose, which committee reported to the Secretary of the Navy the result of their test.

In order to test the machinery under the most unfavorable conditions likely to be experienced in service, the ship was heeled to starboard the greatest angle of heel that could be obtained by any means available, and the guns were run out.

For the purpose of testing the degree of accuracy with which the guns could be pointed, at any desired object, distant objects were selected upon which the guns were trained. It was found that the electrically controlled turrets could be turned through any arc, within the limits of the train, and brought to rest with the object previously selected between the cross hairs of the sighting telescope with great facility, the controller being readily worked with the operator's eye at the telescope and the turret having a smooth and regular motion. While it was possible to arrive at the same result with the steam-turned turret, it was only done with considerable difficulty, owing to the fact that the controlling lever cannot be worked with sufficient facility with the eye of the operator at the sighting telescope, and on account of the jerky movement of the turret. The committee reported that the control of the movements of the turrets given by the electrical mechanism was ample and thoroughly satisfactory while the steam mechanism was not so.

The electrical control was that invented by Mr. H. Ward Leonard and is popularly known as the "Ward Leonard System of Control." As a result of the above mentioned test and the extremely favorable performance of the electrically controlled turrets on the Brooklyn, during its visit to England for the Queen's Jubilee, it was strongly urged that the electric mechanism be installed upon the battle ships Kentucky, Kearsarge and Wisconsin. After a long discussion of the matter and further reports to the Secretary of the Navy, the Ward Leonard system of control was finally adopted for the Kearsarge, Kentucky and Wisconsin and is now being installed upon them.

MR. H. S. JACOBS, a prominent mining engineer, is interested in the project of establishing a large electrical power plant in the vicinity of the City of Mexico. He has just returned from the State of Morelos, where he went to look up the subject. He states that he located a place where 25,000 h. p. can be obtained. It is in the Amacuzac river, sixty-five miles from the City of Mexico. The wires would have to be brought to the City of Mexico over the hills, and he is positive that he could deliver 5,000 to 8,000 h. p. He estimates that the plant would cost $2,000,000 Mexican money. It is stated that the electric lighting plant and many small manufacturing concerns have agreed to take power from the proposed plant as soon as it is placed in operation.

Trolley Freight In Massachusetts.

Several of the Massachusetts trolley companies have petitioned for permission to do an express business, and even carry freight. In some instances, the bill presented to the legislature contains a provision that the case shall be submitted to the people of the municipalities traversed. The Northampton Street Railway, which has had a provision for a two-thirds' popular vote to that effect, comes in with a petition to reduce two-thirds to a majority. It has held one referendum and failed to get the two-thirds. Officers in other places who believe that they can get the two-thirds, do not object to it, but prefer to have the whole business done in the legislature, without submission to the people. In one of the bills a provision was inserted for carrying goods to the weight of 100 pounds, and the vice-president of the road said that they expected to stop their cars at houses by the roadside long enough to take off these parcels. It was testified that the Northampton road has carried crates of strawberries, a quarter of beef, and a barrel of flour. A bill was heard for a general law, but it was strongly opposed by corporation interests. There is a feeling that the progress of the times demands that larger powers be given to street railways in respect to express packages.

Electric Fork for Footpads.

An inventive genius in Media, Pa., has rigged up a device which he confidently predicts will put an end to street car holdups. He is a conductor on an electric line, and has lined the interior of his car with wires charged with electricity. Along these wires runs a small trolley device, which is intended to be kept in his hand constantly, no matter where he may be in the car. It terminates in a fork-shaped metallic rod, and with this rod it is proposed to electrocute any daring footpad who attacks the car.

MECHANICAL

The Hunt Coal Cracker.

THE growing demand for and rapid introduction of automatic stokers to be used under boilers of large steam generating plants, have necessitated the coal to be furnished broken up sufficiently small for feeding it through these modern labor and money saving devices. The Hunt Coal Cracker, illustrated and described below, has been designed for breaking the large

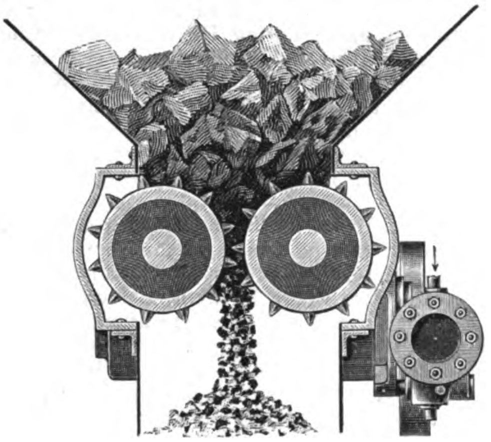


FIG. 1.—HUNT COAL CRACKER, VERTICAL SECTION.

lumps in run of mine of bituminous coal into smaller pieces for the above mentioned purpose. It is believed by many engineers who use hand firing, both in stationary and in locomotive boilers, that it is advantageous to break the larger lumps of coal into smaller sizes, both on account of the easier and more perfect distribution of the coal on the grates by the fireman and a more perfect combustion resulting from an evener fire. The points on the rolls are made of tool steel with hardened points, especially designed to crack and not to crush the lumps of coal so that none of the advantages of lump coal are lost. The fine coal passes through the rolls unaltered.

Figs. 2 and 3 show the cracker driven by a direct connected steam engine having the steam ports and passages all draining continuously downward, the steam entering at the top of the cylinder and the exhaust passing out at the bottom, so that all condensed water is immediately drained off, and every drop of the water from cylinder condensation is swept out of both the cylinder and ports at each stroke of the piston, thus materially

The rolls are made the proper diameter to break the coal to the size required, and are not adjustable in the frame, thus eliminating all elements that might be sources of weaknesses and

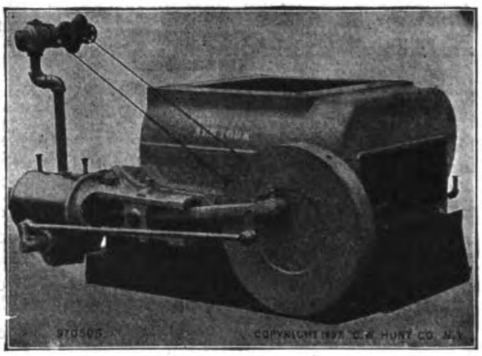


FIG. 2.—HUNT COAL CRACKER, DRIVEN BY DIRECT CONNECTED STEAM ENGINE.

delays. Both the gearing and the rolls are entirely enclosed, each in a separate compartment in a cast-iron frame. This prevents the coal dust from entering either the bearings of the machinery, the gear box, or the room in which the breaker is

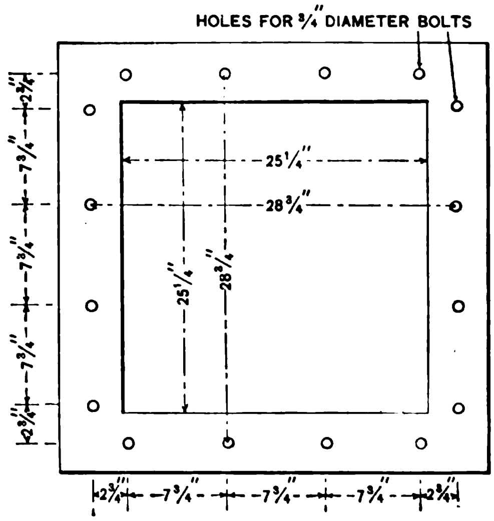


FIG. 4.—LOCATION OF HOLES IN TOP AND BOTTOM FLANGES OF HUNT COAL CRACKER.

located. The gearing is easily accessible, but entirely inclosed and protected from dust while running. The gearing runs in a bath of oil that insures perfect lubrication. The vertical distance between the feeding hopper and the delivery spout is reduced to

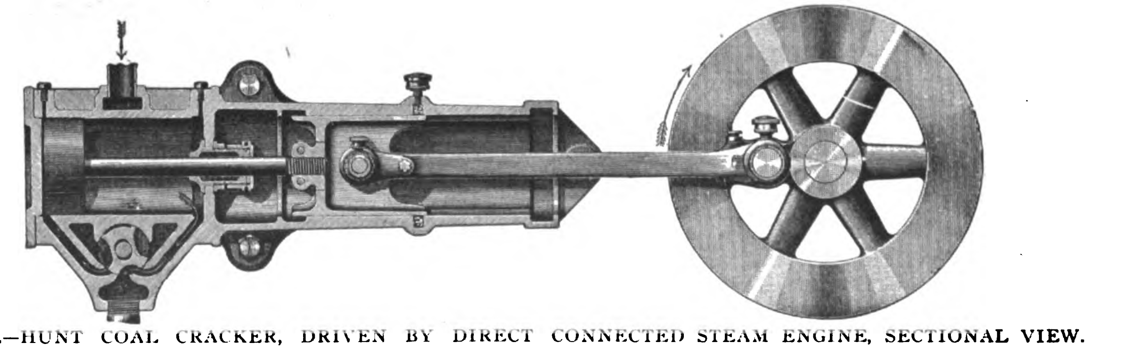


FIG. 3.—HUNT COAL CRACKER, DRIVEN BY DIRECT CONNECTED STEAM ENGINE, SECTIONAL VIEW.

reducing the cylinder condensation. In starting there are no pockets of water to plunge forward and endanger the engine. There is no danger from frost even in zero weather.

The cross-head bearing on the slide is made longer than the stroke of the piston (see Fig. 3), so that it will not uncover a central oil well, packed with an elastic absorbent packing, that keeps the sliding surfaces constantly swabbed with oil. The bearing is unusually wide, so that the bearing on the slide is about four times the area generally used in commercial engines.

a minimum as the space available for the cracker is usually limited. A horizontal spindle governor is adjusted in position and so located as not to interfere with the feeding hopper. The breaker may be placed below the hopper under the railway car track so that the coal feeds directly from the car through the rolls into a conveyer which transports it to the storage bins. When coal is hoisted from a vessel the breaker is usually put under the hopper into which the coal buckets dump.

Fig. 4 shows the exact distance of the bolt holes in both the

top and the bottom flanges of the cracker, which are given here in order that engineers can design and construct the coal hoppers and spouts that will fit the cracker when ordered. The cracker can be bolted directly underneath the lower part of the hopper, or supported on the top of the spout or in any other manner that may be convenient.

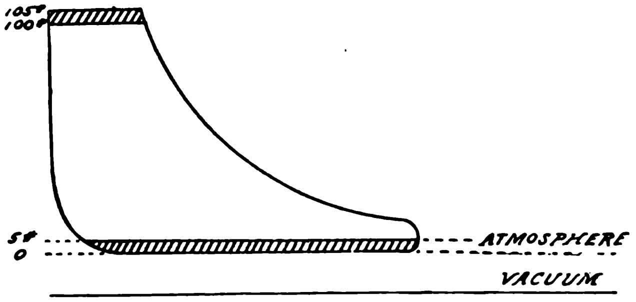
While the average horse power consumed by a coal breaker is small, the necessity for strong and perfect construction of the parts under stress must be evident. The axles in the rolls are of steel, 4⅜ inches in diameter, and the frame is of massive construction to resist the great and sudden strains that may come upon it especially when some foreign substance accidentally falls in the rolls while running. These machines can be used to advantage for breaking other hard substances, the rolls in such cases being made to suit the work. The breaker is self-contained and ready to run when placed in position, thus saving the framing and erecting expenses frequently required with machinery that is not so complete in itself. The breakers are either in stock or in process of construction, and a prompt delivery can be made for standard sizes that break the coal to suit automatic stokers or hand firing. The usual sizes have the rolls 1½ inches, 2½ inches or 3½ inches apart. Rolls will be made to order for other sizes. An electric motor or power from ordinary shafting can be used instead of the steam engine shown in the engravings. The shipping weight is about 7,000 pounds.

Exhaust Steam Heating.

BY GEO. L. THAYER.

THE controversy which has been running in the columns of The Electrical Engineer for the last two months has become interesting from the fact that it has drawn into the discussion some gentlemen who as advocates of two patented systems of steam heating have endeavored to throw all the fog possible upon the question. In plain English it is the "back pressure" versus the "vacuum" systems, the question at issue being the loss of power due to carrying a back pressure of several pounds upon the engine and whether it can be overcome by a corresponding increase in boiler pressure.

Mr. I. H. B., evidently of Lockport, N. Y., throws "theory" to the winds and rests his case upon the statements of the station engineer as to the effect of back pressure upon engine economy. Under actual working conditions for reasons which will be shown later the difference in coal consumption may not be five per cent. either way. On a margin as small as this it is impossible to determine the difference except by an actual test. In an electric light plant it is only during the hour of heavy load that excessive back pressure would cut any figure. The



amount of exhaust is usually greater than the heating system can absorb and part of it will be exhausted into the air. During the hours of light load live steam will have to be supplied to make up for the deficiency, and the amount of back pressure carried will not affect the amount of coal consumed except that due to the increased condensation in the radiators due to the higher temperature of the exhaust steam.

Let us take up the matter of raising the boiler pressure an amount equal to the back pressure carried. Assume the conditions as follows, when the engine is exhausting into the atmosphere.

Boiler pressure	100 pounds.
Point of cut-off	¼.
Back pressure	5 pounds.

Referring to the diagram, the lower shaded area is the area of the indicator card which is cut off when the engine is working under five pounds back pressure. The upper shaded area is that added by increasing the boiler pressure five pounds. As the cut-off occurs at one-fourth the upper shaded area extends only quarter of the way across the diagram, while the lower one extends almost across. Consequently the power developed by the engine at a given cut-off is not regained by increasing the boiler pressure by an amount equal to the back pressure. When working at one-fourth cut-off the boiler pressure must be increased approximately four pounds for each pound of back pressure added. If the boiler pressure cannot be increased the capacity of the engine is reduced and in electric lighting at the very time that the capacity is most needed. But as the cut-off comes later in the stroke the necessary increase in boiler pressure is not so great. At one-half cut-off it requires but double the amount of back pressure to get the same power. If the engine is a compound the maximum cut-off will not be much greater than one-third and the engine capacity suffers accordingly.

The question of the effect of back pressure upon the economy is an entirely different matter. Within the range of reasonable back pressures the amount carried makes no difference in the economy of the engine as long as the demand for exhaust steam is greater than the supply. Possibly an engine builder might make some slight modifications so as to obtain the best compression curve under the new conditions. When, however, the supply of exhaust is greater than the heating system can absorb then the heat wasted is the amount necessary to raise the steam escaping into the air from atmospheric pressure to that of the back pressure carried. With a back pressure of five pounds, steam at 100 pounds, and feed water at 212 degrees, the loss is 18 per cent. of the steam escaping through the exhaust head. This high percentage comes from the fact that the heat necessary to raise one pound of steam from boiling point to say 5 pounds pressure will raise 4.8 pounds through the same range at 100 pounds pressure. At 12 pounds back pressure the loss becomes 25 per cent., and at 31 pounds it becomes 50 per cent. This loss is not as serious as would seem at first thought for not only is it a small portion of the steam generated but the loss will only occur a few hours a day. The cutting down of the reserve capacity of the plant is a far more important thing, for the lighting load comes in the heating season.

In all gravity or back pressure systems an increase of back pressure is a distinct gain in the working of the heating apparatus. The air in the pipes is more thoroughly driven out, radiators heat up quicker, give off slightly more heat, and things work better all around. In central station work, unless the distances are excessive, the back pressure ought not to exceed five pounds except possibly in the coldest weather. When it much exceeds this amount the heating system is likely to prove a serious drag upon the station.

NEWS AND NOTES

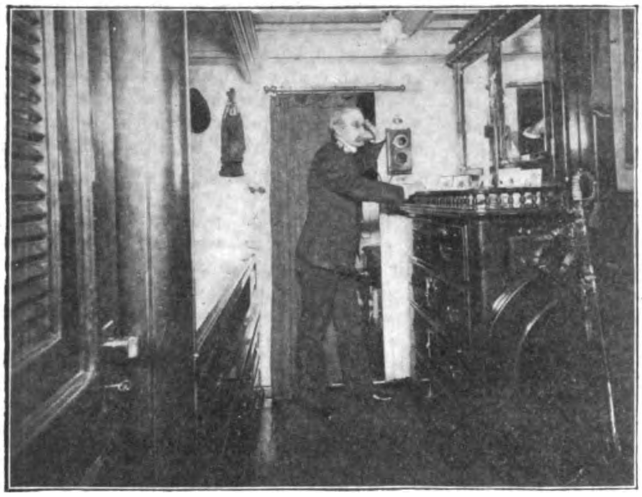
The Electrical Equipment of the Maine.

AT the Bureau of Electrical Equipment of the Navy Department, at Washington, the following facts of interest to electrical engineers, regarding the steam and electrical equipment of the ill-fated battleship "Maine," sunk at Havana, have been obtained. It will be remembered that one suggestion from the Spanish Government to explain the accident, was that the electric light steam plant had exploded. Of this there is said to be absolutely no proof. There were two dynamos and engines directly connected and secured to the same bed plate. The bed plates were made as light as practicable, consistent with necessary strength and rigidity, and had suitable provision for securing tachometers and for catching the waste oil.

The engines were two-cylinder, double-acting, not compounded, and vertical, and were directly connected to the armature shafts by means of flexible couplings, and were capable of driving them at a speed of 500 revolutions per minute when the dynamos were generating their maximum output. The initial steam pressure was 60 pounds; exhaust, either atmospheric or vacuum. The engines were fitted with the most efficient kind of lubricating devices and guards to catch flying oil.

The dynamos were compound wound and self-regulating, producing with 500 revolutions of the armature per minute an electromotive force of 80 volts. Under these conditions each dynamo had a capacity of 25 amperes, and within these limits there was only a variation of 1½ per cent. in speed to produce the required e. m. f. The dynamos were connected to a switchboard from which all of the circuits for incandescent lamps and motors were supplied, and the motors and incandescent lamps could be operated at the same time. A ground detector and two direct reading voltmeters were supplied with the plant. There was no single wire larger than No. 14 B. W. G. used in the wiring, and it had to conform to the naval standards in such cases. The incandescent lamps were arranged in six sections from the switchboard (main). There were three electric motors installed on board, with an aggregate of four horse power. Each motor was directly connected to a countershaft and had a constant speed of 150 revolutions per minute, and were self-regulating and reversible.

There were electrical telegraphs with dials in each engine room and connected to transmitters in the conning tower and in the chart house (or on the bridge), whereby the number of engine revolutions desired could be easily transmitted. These



CAPT. SIGSBEE AT THE TELEPHONE IN HIS QUARTERS ON THE U. S. MAN-OF-WAR MAINE, SUNK IN HAVANA HARBOR.

telegraphs were so constructed that messages could be repeated back from the engine room. There were telegraphs of the same character with repeating dials at all steering wheels and steering engine and connected in the same manner as the engine room instruments, and were so constructed that at all stations the angle was indicated at the same moment. A direct reading rudder transmitter showed the angle of the rudder with the keel and was connected with dials placed on the bridge at the steering engine and in the conning tower. This angle was shown at all stations at the same instant. There were also heeling indicators to show the angle of heel and the angle of roll and were located in the chart house and two other places on the upper deck. The dials of all the telegraphs and indicators were lighted by electricity and the necessary energy was supplied for the instruments from the dynamo circuits. There was a reserve battery for use in case the dynamos were not in operation.

There were in all 237 16 c. p., 151 10 c. p., and 10 32 c. p. incandescent lamps, or a total of 398 lamps; 279 junction boxes, 33 cut-outs, 126 receptacles, 63 switches, and 380 switches. In addition to these there were two large searchlights, one fore and one aft. There were thirty-three voice pipes or telephones on board the ship, eleven buzzers, two bells, two gongs, an automatic water alarm circuit, and twelve 10-inch clockwork alarm gongs with electrical escapements.

Our illustration shows the gallant commander of the "Maine," Captain Sigsbee, using the telephone, located in his apartments on the ship. To remove the suspicion that the explosion might have been caused by defective electrical construction it may be stated that none of the wires was allowed to run near the magazines where the explosives were kept.

Society & Club Notes

American Street Railway Association.

The seventeenth annual convention of the above association will be held at Boston, Mass., on Tuesday, Sept. 6, 1898, continuing in session four days. The exposition, which has always been so important a part of the conventions in the past, will be held in the Massachusetts Charitable Mechanics Association Hall, the largest exposition hall in the country. There will be 60,000 feet of floor space with all the heat, light and power desired. The headquarters of the association will be at the Hotel Brunswick, and the railroads will sell tickets on the certificate plan. All communications should be addressed to T. C. Pennington, Secretary, Chicago City Railway Company, Chicago, Ill.

German Association for Acetylene and Calcium Carbide.

The German Association for Acetylene and Calcium Carbide will hold an exhibition of the recent progress that has been made in this industry, and at the same time a congress to consider the various scientific and practical questions that have arisen in connection with it. The exhibition, which will be held in Berlin from March 6 to March 20, will comprise acetylene generators, lamps, purifiers, and mixing apparatus, acetylene burners, motors, and soldering tools, calcium carbides, electric furnaces, and electrodes, and the different varieties of machinery used in the manufacture of the calcium carbide. Rigorous regulations have been adopted by the Berlin police to prevent any premature explosions, and no generating apparatus using more than about one-half pound of the calcium carbide will be permitted in the main exhibition hall. The use of pure compressed or liquefied acetylene gas will be prohibited, and a limit of 120 pounds pressure has been placed on mixtures of the gas. The use of acetylene gas for illumination is increasing, and the coming exhibition will show how general its application can be made as well as the simplicity with which the gas is generated.

Uses of The Kelvin Quadrant Electrometer.

AT a regular meeting of the Royal Society held on Jan. 27, 1898, Dr. J. Hopkinson, F. R. S., communicated two very exhaustive and interesting papers by Mr. Ernest Wilson. The title of the first paper was "The Kelvin Quadrant Electrometer as a Wattmeter and Voltmeter." The author proves the verification of Clerk Maxwell's formula, that the deflection of the needle of a quadrant electrometer should vary as $(A-B)\left(C-\frac{A+B}{2}\right)$ where C is the potential of the needle, and A and B the potentials of the two pairs of quadrants. The methods of procedure and results of the test were presented in detail by a number of diagrams, curves and tables. The author arrives at the conclusion that the Kelvin quadrant electrometer can be used with accuracy as a wattmeter in the case of alternate currents having any phase relation, and that, as pointed out by Dr. J. Hopkinson, it is necessary to see that within the range of potentials applied, Maxwell's formula is verified. This is, perhaps, best done by applying steady potential differences to the needle and quadrants, and measuring these by Poggendorff's method, employing Clark's standard cell as the unit of comparison. It could also be tested by applying known alternating potentials to the needle and quadrants, the curves being in phase. If it is required to use alternating potentials of high value, such, for instance, as 2,000 volts or more, a suitable transformer could be employed to reduce the potential on the needle. Such unloaded transformer could have the primary and secondary electromotive forces in phase, and of the same wave form, so that no error would be thereby introduced.

The title of the second paper by the same author was "The Magnetic Properties of Almost Pure Iron." Some interesting hysteresis curves are presented in this paper and the author made a thorough investigation of the apparent magnetic instability of the specimens under test. Regarding this property he makes

the following statement: It has already been nцticed, and is well known, that if the magnetizing force be varied from one maximum value through zero to a value equal, say, to the then coercive force of the material, that tapping the specimen will produce a considerable change of induction; or, if the observed kick on a ballistic galvanometer (in circuit with a secondary coil wound on the specimen) due to such change be added to the observed kick when the magnetizing force is raised to the opposite maximum, the sum does not equal the whole kick which would be observed if the force were at once varied from the one maximum to the other. During the interval the magnetism appears to continue to settle down, so that the change which lastly takes place is not so great as it would be if such apparent settling down did not occur.

ELECTRICAL EXHIBITION. FROM MAY-2 TO MAY-31-

Details of The Telegraphic Tournament.

WITH regard to the telegraphic tournament to be held at the Madison Square Garden during the Electrical Exhibition in May, the Telegraph Age announces that the events so far arranged will include:

A message class for receivers, transmission thirty minutes, receivers to use typewriters of their selection.

Novice class, open to persons not having an official record; sending five minutes.

Championship class, open to all, sending five minutes, with prizes for receivers.

Ladies' class, free for all, sending five minutes.

Two-forty-word class, open to those not having an official record of 240 words or better, sending five minutes.

Two-thirty-five-word class, open to all who have not an official record of 235 words or better, sending five minutes.

Two-thirty-word class, open to all who have not an official record of 230 words or better, sending five minutes.

Two-twenty-five-word class, open to all who have not an official record of 225 words or better, sending five minutes.

An entrance fee of $2 will be charged.

Mr. James D. Reid has been asked to present the prizes to the winners. Mr. Thos. A. Edison is taking great interest in this tournament, as he always does in such affairs, and he will make a phonographic record of the best transmissions, noting the exact time of the revolution of the machine so that perfect reproductions can be made at any future time. The contestants will thus be enabled to have an exact record of their own work, which they can listen to whenever they feel so disposed.

Among the judges proposed for the telegraph events are: J. H. Bunnell, telegraph supplies, and an old-time telegrapher; E. A. Leslie, president of an electric light company, and an old-time telegrapher; A. S. Brown, electrical engineer of the Western Union Telegraph Company; A. E. Sink, manager of the Western Union Telegraph Company, 195 Broadway, New York; Francis W. Jones, electrical engineer of the Postal Telegraph-Cable Company; Geo. H. Usher, superintendent of the Postal Telegraph-Cable Company, New York; E. H. Cox, manager of the Associated Press, New York; Thos. J. Smith, electrical supplies, and an old-time telegrapher, and Thos. R. Taltavall, editor of the Electrical World; and as judges of the typewriting contest, Chas. W. Price, editor of the Electrical Review; T. C. Martin, editor of The Electrical Engineer; W. D. Weaver, editor of the American Electrician; J. B. Taltavall, of Telegraph Age, and E. W. H. Cogley, assistant superintendent of telegraphs of the Associated Press, New York.

Those wishing to communicate with Mr. Fred. Catlin, the manager of the tournament, can do so by addressing him, care of Post Office box 2403, New York.

INTERNATIONAL TYPAL TELEGRAPH COMPANY has been formed at Detroit by W. F. Jarvis, T. S. Jerome and W. H. Flynn, with a capital stock of $10,000.

REPORTS OF COMPANIES

New Orleans Traction Co.

The annual exhibit of earnings and expenses is as follows:

	1896.	1897.
Gross earnings	$1,334,276.52	$1,239,256.04
Operating expenses	748,547.77	847,842.86
Net earnings	$585,728.75	$391,423.18
Decrease for 1897		$194,305.57

The operating expenses of the electric lines, which were 55.81 per cent. in 1896, were 68.40 per cent. in 1897. The total operating expenses which were 56.1 per cent. in 1896, were 68.40 per cent. in 1897. The year's fixed charges and other deductions left a net deficit of $80,741.65, against a surplus of $68,448.37 in 1896. The number of passengers carried was 23,998,216, against 25,969,538 in 1896. The net earnings per car mile were 4.29 cents, against 6.35 cents in 1896. The yellow fever epidemic, now past, is responsible for the poor showing of 1897, but the January showing is a remarkably good one.

THE STOCK MARKET

Harping On Cuba.

There can be no question as to the disturbing effect of Cuban affairs on the American market, but it is not so extreme as supposed. For example, last week, while some sixteen railroad securities went down about one point, twenty advanced. It was pretty much the same way all along the line,—erratic but in general wonderfully steady. The present week may see a change, depending on the course of affairs, but it is by no means certain that a declaration of war would send prices lower. The stimulus to trade and transportation of a big extra demand for all manner of supplies might send them up. During last week, on sales of 22,683 shares, Western Union opened at 86⅝ and closed at 86¾. General Electric on sales of 12,270 shares opened at 32 and closed at 31¾. On sales of 850 shares, American Bell Telephone began the week at 251 and closed at 262. Speaking of trade as a whole, Bradstreets says: "Nearly all signs point to an unprecedented volume of business being done or arranged for at the present time."

Copper is up again, being now 11.87½ cents. Steel rail, heavy, is steady at $18.

PATENT NOTES.

Field Rheostats Having Separable Steps.

A patent was issued Feb. 8, 1898, to H. Ward Leonard the claims of which relate to field rheostats in which the insertion of resistance causes a reduction in the current strength, and in which the resistance is composed of separable unit steps and carried by a common support. Mr. Leonard says: "Such rheostats have been placed upon the market by two different concerns. Neither of these concerns are licensed under my patent, and I propose to promptly institute suit against infringers. In addition to the present patent I am the owner of several other patents, the claims of which are also infringed by the field rheostats of the other manufacturers referred to."

A typical claim in the patent issued Feb. 8 to Mr. Leonard which is No. 598,568 is as follows: "Claim No. 3. A rheostat having in combination a number of separable resistance steps, each step of resistance being of practically the same size and design and the ohms of a series of the steps being tapered progressively and a common support for the steps of the resistance, substantially as set forth."

INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents Issued March 1, 1898.

Alarms and Signals:—

APPARATUS FOR VISIBLE SIGNALING. L. Sellner, Vienna, Austria-Hungary, 599,742. Filed March 28, 1896. Relates to improvements in apparatus for visible signaling, more particularly for use at night and in localities, such as ships, the position of which is liable to be changed.

Batteries, Secondary:—

PLATE FOR ACCUMULATORS. W. Majert, Grunau, Germany, 599,-718. Filed August 19, 1897. Comprises the plate or bar having corrugations therein of the shape of the half of a cone when divided on the line of its axis.

Conductors, Conduits and Insulators:—

PNEUMATIC TRAVELER FOR PIPES OR CONDUITS. L. C. Kohler, Milwaukee, Wis., 599,713. Filed June 16, 1897. Adapted under pneumatic pressure to travel through a pipe drawing with it a cord.

FLEXIBLE ELECTRIC CONDUCTORS. A. Bournonville, Philadelphia, Pa., 600,058. Filed November 20, 1897. Improvement in the manufacture of flexible conductors, such as telephone cords.

STRAIN INSULATOR. H. Carmichael, Malden, Mass., 600,063. Filed June 13, 1895. Consists of interlocking metallic members, an interposed body of insulating material incompressible at the temperature and tension of use specified, an enveloping mass of insulating material compressible at the temperature and tension of use, and an inclosing jacket for the compressible insulating material.

TELEGRAPH CABLE. J. J. Hall, Slough, Eng., 600,073. Filed Oct. 4, 1897. Consists of a plurality of conductors each provided with a wrapping of a netted textile fabric secured thereon by a spirally wound textile thread or yarn, the conductors being laid in a bunch in the form of a cable, and a textile cord wound spirally around the whole.

Distribution:—

TRANSFORMATION OF ALTERNATING CURRENTS INTO DIRECT CURRENTS. A. Muller, Hagen, Germany, 599,789. Filed July 30, 1897. An electroreceptive device capable of generating a counter electromotive force substantially equal to the electromotive force of the alternating current.

SYSTEM OF ELECTRICAL DISTRIBUTION. B. G. Lamme, Pittsburg, Pa., 599,943. Filed September 18, 1897. Means for varying the electromotive force of a circuit or feeder automatically in proportion to load.

Dynamos and Motors:

ELECTRIC MOTOR. O. H. Pieper and A. F. Pieper, Rochester, N. Y., 599,791. Filed October 17, 1896. Improved circuit arrangement and switches whereby sparking at the switch is prevented when the current from a line is cut off.

ALTERNATING CURRENT MOTOR. W. Stanley, Pittsfield, Mass., 599,810. Filed May 9, 1896. Relates to a novel type of induction-motor to be operated by phase-differing alternating currents. It is constructed with a single primary element of field magnet structure and a single secondary core wound with closed coils.

VARIPOLAR MOTOR OR DYNAMO. H. H. Wait, Chicago, Ill., 599,815. Filed August 20, 1896. A double set of armature windings connected with separate commutators which are in connection with a switch adapted to connect the windings either in series or parallel to vary the range of the speed of the motor, while by a continued movement of the switch the effective poles of the fields may be varied in number to produce the same result.

ELECTRIC MOTOR. E. McNerney, Pittsfield, Mass., 599,913. Filed May 22, 1897. Reciprocating electric motor.

NON-SYNCHRONOUS ELECTRIC MOTOR. B. G. Lamme, Pittsburg, Pa., 599,940. Filed April 30, 1894. A form of winding for the primary members of rotary field motors which, when supplied with multiphase currents, will produce a rotating field that closely approximates in effect a single pole of uniform strength mechanically rotated.

DIRECT CURRENT ELECTRIC MACHINE. B. G. Lamme, Pittsburg, Pa., 599,941. Filed May 8, 1896. Has field magnets with inwardly projecting pole pieces provided with relatively narrow magnetic pole-shoes which project laterally from the pole-faces and serve to increase the width of the fringe of the magnetic field.

INDUCTOR MOTOR. B. G. Lamme, Pittsburg, Pa., 599,942. Filed July 12, 1897. A magnetizing-coil provided with a magnetic circuit having a relatively wide air-gap and a relatively narrow air-gap, in combination with a set of generating coils adjacent to the wide air-gap.

CURRENT COLLECTOR FOR DYNAMO ELECTRIC MACHINES. G. W. Nell, Philadelphia, Pa., 600,088. Filed February 23, 1897. Intended to overcome the objections which are incident to the commutators and brushes now generally employed in connection with this class of machinery.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. P. Warner and H. H. Wait, Chicago, Ill., 599,818. Filed March 16, 1897. Consists of a chimney of insulating material by which the lamp is supported. Ducts therein adapted to receive and protect the feed rod and the conductors leading to the lamp, and a hood adapted to protect the insulating chimney from moisture.

ELECTRIC ARC LAMP. C. Tepel, Bennett, Pa., 599,880. Filed December 31, 1896. An arc lamp provided with an electro-magnet feeding mechanism and a vertically movable slotted tubular holder for the upper carbon, in combination with a mechanical feeding mechanism provided with a slotted tubular holder for the lower carbon, and a positive differential feed, whereby the arc is maintained at the one point.

INCANDESCENT ELECTRIC LAMP. J. T. Lister, Cleveland, Ohio, 599,910. Filed October 2, 1897. Comprises a single lamp bulb with two filaments with means for connecting either filament separately with the lamp circuit through the circuit contacts.

ELECTRIC ARC LAMP. H. P. Davis, Pittsburg, and F. Conrad, Wilkinsburg, Pa., 599,931, Filed August 22, 1896. A feeding and brake mechanism for arc lamps, comprising a supporting-frame, a feed wheel and chain, and a brake wheel geared to the feed wheel.

PORTABLE ELECTRIC LAMP. L. Paget, New York, 599,975. Filed July 8, 1897. Type of portable electric lamp which utilizes batteries as the source of current supply,, such, for instance, as are used in connection with hand lamps or lanterns, bicycles, carriages, and analogous vehicles.

Miscellaneous:—

ELECTRICALLY OPERATED HOISTING MACHINERY. A. J. Shaw, Muskegon, Mich., 600,092. Filed May 6, 1893. An arrangement of electrical circuits and connections as applied to hoisting machinery, and particularly as related to a traveling bridge crane.

Railways and Appliances:—

COLLECTING CURRENT DEVICE. L. Gutmann, Peoria, Ill., 599,-781. Filed April 26, 1897. The combination with a body portion of gauze conductor, of a strip of insulating material, and a superposed stratum of conducting material electrically connected with the gauze at one extremity of the brush.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS. S. H. Short, Cleveland, Ohio, 599,807. Filed November 13, 1897. A system wherein one or more cars throughout the train are equipped with controlling and braking apparatus and may be operated independently when detached from the train or in co-operation with the other cars when connected up in a train.

ELECTRIC RAILWAY. W. M. Brown, Johnstown, Pa., 599,828. Filed October 7, 1897. A traveling magnetic closer having a compound winding comprising a winding receiving a shunt-current from the main circuit, and a second winding receiving a current from the main circuit only when the current is passing to the motors, in combination with an independent source of current supply and means for passing current therefrom through the second winding when the main circuit falls abnormally.

ELECTRIC CAR TROLLEY. W. H. Russell, Newcastle, Canada, 599,-868. Filed April 18, 1896. A trolley wheel bearing that shall make the wheel less liable to be thrown off the trolley wire.

MAGNETIC CLOSER. J. N. Thomas, Johnstown, Pa., 599,881. Filed October 19, 1897. Magnets of that type which are carried by electric vehicles to actuate a current conveyer placed between the bared working conductor and the source of supply.

ELECTRICALLY PROPELLED VEHICLE. P. R. Salberg, Pittsburg, Pa., 599,947. Filed February 5, 1896. Mechanism for operating and controlling railway cars intended for heavy traffic and to be run at high speeds.

SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. D. Urquhart and F. Wynne, London, Eng., 600,101. Filed February 25, 1897. System of wiring for surface contact electric railways.

THIRD RAIL. L. M. Maxham, Boston, Mass., 600,009. Filed June 7, 1897. Electric conductors for railways in which the conductor being located upon the roadbed it is desired to insulate the same from all possible contact with the people or animals crossing the track.

Regulation:—

METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS. S. H. Short, Cleveland, Ohio, 599,804. Filed May 19, 1897. Consists in maintaining a substantially constant or uniform accelerating current until the desired speed has been attained, and thereafter reducing the current thereby maintaining a uniform speed.

METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS. S. H. Short, Cleveland, Ohio, 599,805. Filed May 19, 1897. Similar to above.

METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS. S. H. Short, Cleveland, Ohio, 599,806. Filed May 19, 1897. Similar to No. 599,805.

ELECTRIC REGULATOR FOR DYNAMOS. W. H. Chapman, Portland, Me., 599,892. Filed February 10, 1897. A solenoid having a movable iron core, and composed of four distinct coils of wire arranged to oppose each other and to balance each other's magnetic and mechanical action on the core, and to thereby neutralize each other's effects whenever an even number of them is in action, and to pull the core one way or the other when an odd number of them is in action.

METHOD OF AND APPARATUS FOR REGULATING ELECTRIC MOTORS. B. Frankenfield and D. C. Jackson, Madison, Wis., 599,-932. Filed January 28, 1897. Method of varying the speed of a multipolar motor, which consists in weakening and strengthening the magneto-motive force due to the coil exciting one or more of the poles, while leaving the magneto-motive force due to the coils exciting one or more of the poles unchanged.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRIC SWITCH. G. Doyle, Brookline, Mass., 599,692. Filed August 14, 1896. Details of construction.

RHEOSTAT. S. H. Short, Cleveland, Ohio, 599,803. Filed May 14, 1897. Consists of a spider having radial arms adapted to receive the resistance material in spiral convolute layers between them, and means for attaching the motor-circuit terminals to such resistance material.

ELECTRIC CONTACT DEVICE. J. L. Buchanan, Johnstown, Pa., 599,891. Filed February 4, 1897. A frame and a plurality of laterally movable rollers carried thereby and having flanges extending completely over the conductor.

QUICK BREAK SWITCH. H. P. Davis, Pittsburg, Pa., 599,929. Filed July 22, 1897. Comprises two stationary jaw-terminals having laterally yielding resilient sides.

SWITCH FOR ELECTRIC CIRCUITS. H. P. Davis, Pittsburg, Pa., and E. F. Harder, Wilkinsburg, Pa., 599,930. Filed October 28, 1896. Consists of a stationary jaw-terminal and a movable blade having spring plates or washers riveted to its sides, the outer side faces of which make contact with the stationary jaw-terminal.

SWITCH FOR ELECTRIC CIRCUITS. G. Wright, Wilkinsburg, Pa., 599,954. Filed September 18, 1897. A double throw switch, comprising stationary socket terminals, co-operating plungers and a pivoted operating-lever having arms provided with cams for engaging and actuating the plungers alternately in opposite directions.

CENTRIFUGAL RESISTANCE CONTROLLING DEVICE. G. H. Whittingham, Baltimore, Md., 600,051. Filed July 29, 1897. Comprises a revoluble head; resistance coils arranged in circles thereon; a pivoted switch-arm also on the head, and a centrifugally-operated lever connected with the switch-arm.

ELECTRIC SWITCH. J. J. Flint, Denver, Colo., 600,112. Filed Feb. 16, 1897. Details of construction.

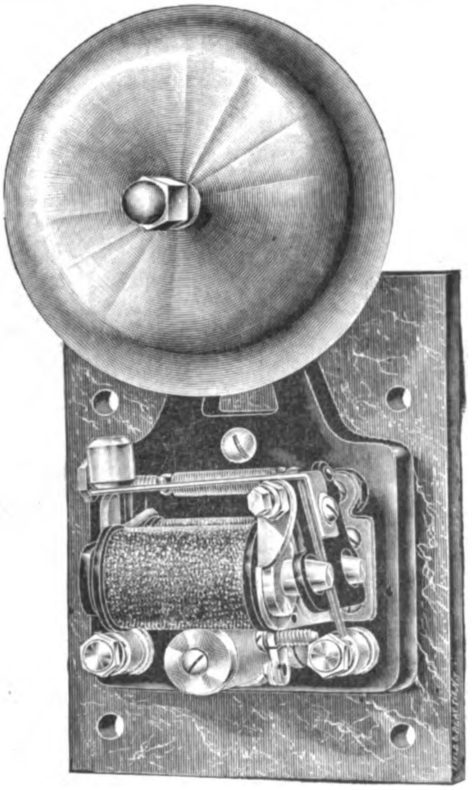
Telephones:—

TELEPHONE TRANSMITTER. J. H. Rogers, Bladensburg, Md., 599,867. Filed March 9, 1897. Consists of a fixed electrode, a movable electrode mounted thereon, and an elastic conical sounding board or target depending from the movable electrode.

TRADE NOTES & NOVELTIES

High Tension Current Bells.

MESSRS. EDWARDS & CO., of 144th street and Fourth avenue, New York, have lately put on the market gongs for use on electric light circuits. The cut illustrates their well known "Vigilant" bell, arranged for this class of work. Any of their bells, either electric or electro mechanical can be furnished to meet the same conditions. This style of bell is mounted on a marbleized slate base and arranged to operate on



"VIGILANT" HIGH TENSION CURRENT BELL.

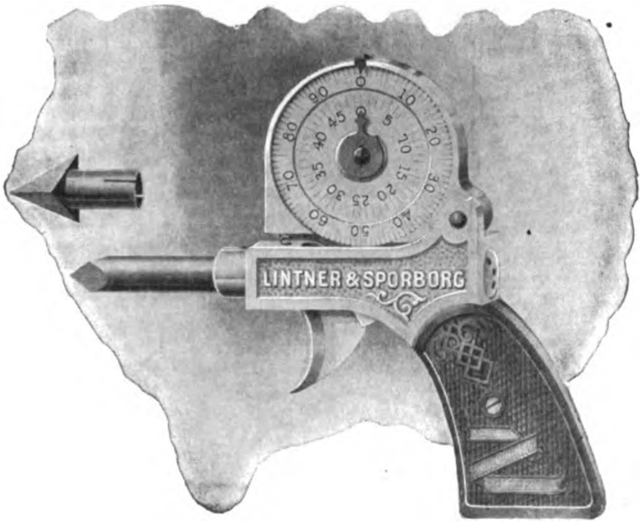
currents up to 500 volts. The new feature of this article is the use of a special resistance substance, which will neither melt nor burn, which is placed in the circuit of the bell. The armature being attracted, shunts the coils of the magnet, leaving the resistance in the circuit so that there is no sparking and the contacts cannot burn out. It is very economical as at no time can more than one-sixth of an ampere pass through the bell.

The Bullock Electric Manufacturing Co.

In about two weeks the Bullock Electric Manufacturing Company will begin the erection of its new plant at Norwood, Ohio, about four miles from Cincinnati. The contract for the steel structural work has been let and bids are now being received on engines, boilers, etc. This plant will consist of large machine shops (300 x 100), brass foundry, pattern and office buildings and power house, and will have a capacity of four or five times the present Bullock plant. The company is now ordering many new machine tools and their shop will contain the finest machinery in the market, as well as the latest electrical apparatus. In nearly all cases each tool will have a motor directly attached to it. Belting and shafting will thus be reduced to a minimum. It is the desire of the company to make this a model plant and the shop will, no doubt, contain many new and interesting features.

The "Paragon" Ball-Bearing Speed Indicator.

THE improved and perfected speed indicator illustrated below is the result of a good deal of experimenting and expenditure of time and money. It has been placed on the market by Lintner & Sporborg, Gloversville, N. Y., and possesses the following admirable features: It has a pistol-form grasp, by which the contact is made, and a trigger-form lever for starting the connecting mechanism, just the form of mechanical appliance to secure accuracy at starting and stopping. Made as it is with ball bearings to take up the end thrust friction, the latter disappears as a defect, and does not interfere with and make an incorrect record and having reversing worm-gears to actuate the dial, the indicator turns in the same direction with opposite revolutions of the shaft, so that its recordings do not have to be



"PARAGON" BALL-BEARING SPEED INDICATOR.

read backwards, when revolutions opposite that shown in the dial are recorded. To the manufacturer using power, the "Paragon Speed Indicator" will prove of great value, for by it the fact can readily be determined as between the revolutions of a main driving shaft where the speed is multiplied therefrom with belt connection to other shafts, and whether the latter are doing their work without intermediate loss and waste of power, and in many cases by being able to determine these and other facts with accuracy, it will in a year save a hundred times its cost.

A Hard Rubber Combination.

A combination for the purpose of regulating and protecting prices has been formed by the three largest hard rubber manufacturers in the country, which are to be consolidated into one concern. They are the India Rubber Comb Company, whose works are located at College Point, N. Y.; the Butler Hard Rubber Company, of Butler, N. J., and the Goodrich Company, of Akron, O. The concern will be incorporated under the laws of New York, and with a capital stock of $2,500,000. Of late years prices have been badly cut, and it is hoped to keep them at a normal level by this consolidation.

New Walker Installations.

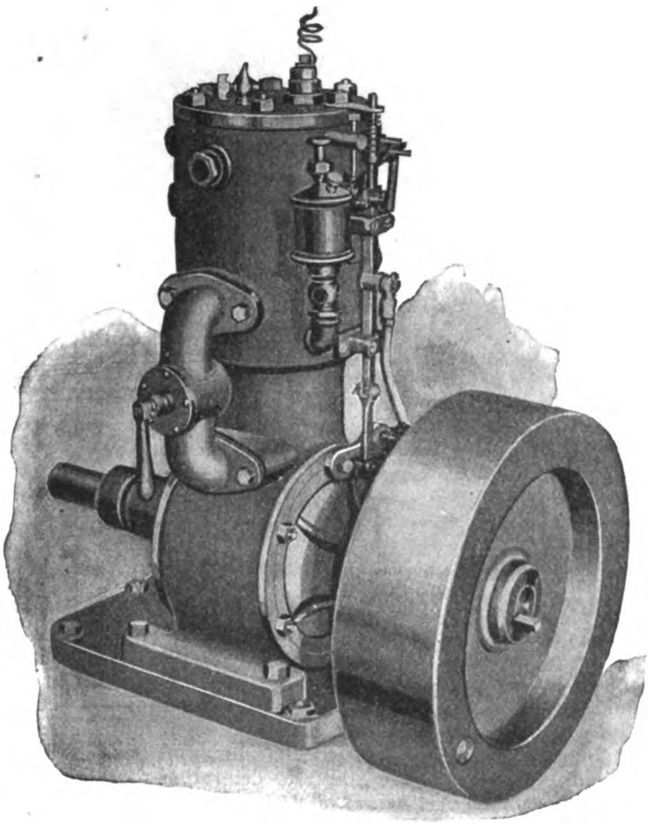
The Walker Company will shortly install two 6-pole 100 kilowatt lighting generators in the Metropolitan Museum of Art in New York. The Presbyterian Hospital has also placed an order with the company for a 100 kilowatt generator and switchboard. A Walker alternator, 3-phase 60 cycle for lighting and power has been purchased by C. Burkhart, of Hudson, Wis., while the Los Angeles Traction Company, of Los Angeles, Cal., has ordered a 500 kilowatt railway generator of the belted type and a generator panel for the switchboard.

Among the electric railway equipments recently ordered may be mentioned 10 double 3 S equipments with type S controllers sold to the Erie Construction Company for the Buffalo Traction Company; 3 double 40 horse-power equipments with S con-

trollers to Isaac A. Walker & Son for the Quakertown (Pa.) Traction Company, and two double 3 S equipments for storage battery motor cars to S. M. Fisher for the Patton Motor Company.

The Mianus Gas and Gasoline Engines.

THE steadily increasing popularity of gas and gasoline power for driving machinery and for propelling boats and vehicles, has led to the perfection of a gas and gasoline engine by the Mianus Electric Company, Mianus, Conn., which is peculiarly fitted to supply the demand, excelling in economy, safety and durability. The company are manufacturers of complete gas or gasoline engines of from one to six horse power, both stationary and marine, and can supply the castings, parts and working drawings for the one horse power and two and one-half horse power engines, for experimental purposes and for those who wish to construct their own engines. The accompanying illustration shows the two and a half horse power "Palmer" marine gasoline engine, built on the two cycle compression type, with an impulse at each revolution of the crank. The company also build them on the four cycle type having an impulse every other revolution. These engines are readily adapted to motor carriages and are also used for running printing presses and dynamos for electric lighting. They occupy but little space and consume a small quantity of gasoline or gas.



"PALMER" MARINE GASOLINE ENGINE.

Electric Motors For The Brooklyn Navy Yard.

The Bullock Electric Company has received orders from the Secretary of the Navy for twelve motors for use in the machine shops in the Brooklyn Navy Yard. The motors range from 5 to 40 h. p., are wound for 220 volts and are either to be direct-connected or belted, and several will be attached to the ceiling. The dustproof starting boxes for these motors were manufactured by the Iron Clad Rheostat Company.

Ball Engine Co.

On account of the great demand for their engines for electric light and power purposes, the works of the Ball Engine Company, Erie, Pa., builders of the Ball engine, have been operated night and day since Sept. 1.

Upton "Midget" Enclosed Arc Lamp.

THE "Midget" enclosed arc lamp, manufactured by the Standard Thermometer and Electric Company, Peabody, Mass., has given so highly satisfactory results that future installations by the company of arc lamps on 6.7 ampere circuits will doubtless be confined largely to the enclosed long burning type. Its advantages over the open arc lamp are many and valuable.

With the "Midget" lamp, shown in Figs. 1 and 2, a variation of from 4½ to 7 amperes does not affect its satisfactory operation; or, if desired, the arc machine can be run constantly at 6 amperes or less, affecting the candle power very slightly, and making a saving of course in fuel. Few types of open or enclosed arc lamps will stand a variation of even one ampere without seriously interfering with their steady operation. The "Midget" lamp burns steadily, without any flicker or shadow, diffusing the light more evenly and at a greater distance from the lamp than the open arc. In the latter, the light is most brilliant directly beneath the lamp, and the diffusion not nearly so efficient.

Actual tests have proven to the satisfaction of users, that the enclosed arc series lamp taking from 65 to 75 volts, (averaging 70) at the arc at 6 7-10 amperes, gives fully as desirable a light as the open arc lamp taking 45 to 50 volts on 9 8-10 ampere circuits. The saving in carbons resulting from trimming the lamp only once in 125 hours instead of every day is considerable. On large installations the saving of labor is also an important item. The arc of the lamp being enclosed is not affected by snow-storms or inclement weather, as in the case of open arc lamps. The cut shown illustrates the indoor type, as well as the mechanism. The lamp is designed to fit standard hanger boards and hoods for street service.

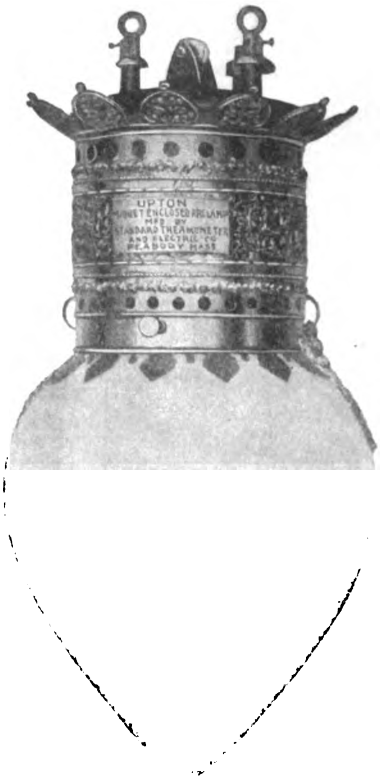


FIG. 1.—MIDGET ENCLOSED ARC LAMP.—EXTERIOR VIEW.

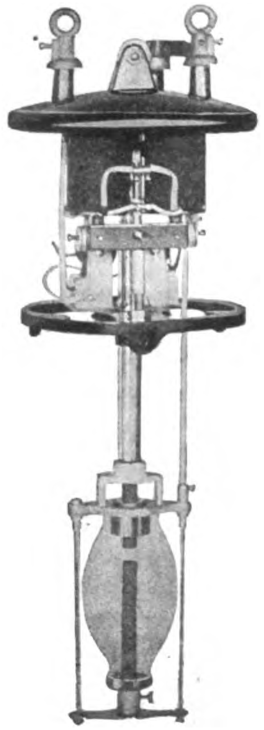


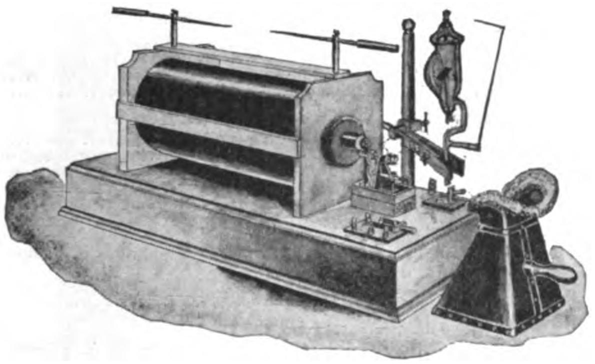
FIG. 2.—MIDGET ENCLOSED ARC LAMP.—INTERIOR MECHANISM.

An automatic cut-out is provided with each lamp. It is constructed with an especial view to economical operation. All the energy expended in the lamp is consumed at the arc and not taken up by heavy series coils. It is not a differential lamp, but a plain shunt lamp with a series winding for starting, thus enabling it to operate without injury on circuits varying from 4½ to 7 amperes without readjustment. The candle power of the lamp can also be raised or lowered irrespective of the amperes by a simple method of lengthening or shortening the arc. If for any reason the voltage at the arc goes above 80, the cut-out operates, shunting the current through the series coil and

restarting the lamp. If the carbons are burned out or stuck, the lamp remains out of circuit at a loss of three volts necessary to hold the cut-out. Station managers will find that in this lamp the constantly recurring troubles on account of burnt-out magnets, worn-out clutches, and jammed carbon rods have been overcome. The lamp contains no springs nor dash pots, the absence of which is of especial interest to station managers who have experienced these difficulties. The only moving part of the "Midget" lamp is the magnet core with its clutch. The mechanism is easy of access, and method of trimming the same as in the other "Midget" lamps described in a previous issue.

Williams' New X-Ray Coils.

THE extensive introduction of commercial X-ray apparatus has had the effect of developing and improving it so as to meet all practical conditions. Induction coils, tubes, fluoroscopes, condensers, vibrators and sensitive plates have all received the closest attention of experimenters and this has resulted in placing very efficient apparatus in the market. The coil illustrated below is the result of long study and experimentation by Mr. E. Q. Williams, 316 and 318 East Water street, Syracuse, N. Y. The coils are made in all sizes, giving sparks of from 3 to 15 inches. This length is rated for a continuous spark and not for an exceptionally long flash which may be obtained occasionally. The coils are wound with No. 34 wire,



WILLIAMS' X-RAY COIL.

and with ¾ pound of wire, a one inch spark is obtained which is highly calorific. The coils are insulated by a new and original method, designed by Dr. Eugene Haanel, of the Syracuse University, which insures perfect insulation between the primary and secondary coils and between the sections of the coils themselves. The vibrator is of the latest type and breaks the circuit when the hammer is in full swing, giving a long make and a very short break. A weight is attached to the hammer which can be adjusted so as to change the rate of vibration. The condenser is made in sections and is adjusted by turning the handle shown at the right, which cuts the various sections in and out. The materials used in these coils are all selected to give the highest efficiency and long life. The coils are made for either battery or 110 volt d. c. circuits, with or without the vibrator attached.

An Improved Sand Box.

THE Ham sand box, illustrated herewith and sold by the Electric Appliance Company, of Chicago, is based upon the theory that any box provided with a valve at its bottom is impracticable; and if the valve be made tight enough to prevent the sand from sifting through, it will require great force to operate it, while if the valve be loose enough to work easily, it will allow the sand to sift around it.

In the No. 3 Ham sand box illustrated, all parts are made of bronze metal. It has an opening in the box, under which is a curved shelf. The ends of the shelf extend beyond and above the opening in the box, so the sand cannot escape by gravity. A paddle is reciprocated above the shelf, and the movement of the paddle forces the sand in each direction alternately over the ends of the shelf to the feed spout which leads to the car track. Above the paddle are two fingers which stir the sand. The connecting rod passes forward to the car platform, and is operated by a pin and ball crank lever, or by a hand lever. The working parts are extremely simple and the motions direct. The strokes of the foot or hand may follow each other so rapidly as to practically secure a continuous, but small, stream of sand, a decided advantage in hill climbing. It can be easily seen that waste is impossible in this box, as the sand flows only when the lever is in motion, and the quantity of sand is regulated. Small stones or other small substances will not interfere with the operation of this box, but will pass freely through it. In fact,

HAM SAND BOX COMPLETE AND IN SECTION.

the company recommends coarse in preference to fine sand, even if it contains gravel stones as large as peas, as it is less likely to pack in the box. The manufacturers state that they have unsolicited testimonials favorable to the box, received from prominent railroad men.

CATALOGUES.

Switch Catalogue of Zimdars and Hunt.

A very handsome and useful catalogue has just been issued by Zimdars and Hunt, 127 Fifth avenue, New York, manufacturers of knife switches, switchboard fittings and electric light and power specialties. The apparatus manufactured by this company is of the very best quality, all current carrying parts being made of pure drawn Lake Superior copper of the highest conductivity. Great care has been bestowed on the mechanical points, both in design and construction. Symmetry and beauty of design have also not been neglected and the trimmings are of neat and effective patterns. The catalogue contains illustrations and price lists of all types and sizes of switches, as well as switchboard connections and instruments. The cover of this very artistic catalogue is an imitation of the marbleized slate bases employed by the company.

Lakon Transformers.

The Western Electric Company has recently issued Bulletin No. 25 descriptive of the Lakon transformer. This bulletin illustrates the iron stampings from which the transformers are built up; several different sizes of transformers, and the methods of connecting them to obtain either 50 or 110 volts; also hanging device and special fuse box.

The Lakon transformers are made for long distance transmission for the ordinary 1,000 and 2,000-volt primary and 110 and 50-volt secondary for 3-wire system and for arc light transmission. They are all insulated and can be run either as dry transformers or oil insulated transformers.

The Lakon transformers have no joints on the top or sides the only joint being on the bottom, thus making the case thoroughly weatherproof without the use of cement or other material to fill up the cracks. The larger sizes are placed in either an open case for inside use or in weatherproof case for outside use.

The Harrington System Labor-Saving Appliances.

Edwin Harrington, Son & Company, of Philadelphia, Pa., have issued a very complete catalogue illustrating their well known hoists, tramways, traveling cranes, tools, and special machinery and labor-saving devices. The hoists manufactured by this company were introduced twenty years ago, and have been adopted by the United States Government. It has independent working chains, the load being carried on two distinct chains, each link having a breaking strain greater than the rated capacity of the hoist; this reduces the possibility of accident. Some of the apparatus illustrated in the catalogue are the double hook screw hoist, the twenty thousand pound hoist, the rope winch, combined hoist and electric motor, single track railway, combined hoist and traveler, turn tables, wall and arm cranes, and illustrations showing the use of overhead tramways in storerooms and factories.

NEW YORK NOTES.

DR. DURAND WOODMAN, analyst and chemical expert, has just issued a circular informing his friends and clients that, to meet the increasing demands of his professional work, he has taken additional laboratory and office room, and telephone service, the latter especially being a convenience for out-of-town clients. These additions will facilitate not only the work of the department devoted to commercial analysis, but also the experimental and expert work for inventors, patentees, their attorneys, and solicitors, as well as the technical investigations for manufacturers and others. As in the past, everything pertaining to inventions or manufacturing processes entrusted to Dr. Woodman will be held strictly confidential. Dr. Woodman's offices are at 80 Beaver street; telephone, 1413 Broad, New York.

MR. GEO. T. HANCHETT has opened an office at 123 Liberty street, where he will continue his practice in electrical engineering, and will make a specialty also of electrical and mechanical machine design. He has complete facilities for making drawings and constructing machinery and models under close supervision.

MR. S. B. CONDIT, of the firm of L. A. Chase & Company, Boston, recently visited New York and has made arrangements with Mr. Nisbet, president of the Electrical Appliance Company, 39 to 41 Cortlandt street, to handle their gravity motor controllers for the entire East. Under the new conditions we are informed the Electrical Appliance Company will be obliged to greatly increase the present output of their new factory, located at Hoboken, N. J.

THE DIAMOND STATE TUBE COMPANY, Elsmere, Del., have recently put on the market a waterproof, fireproof tubing for electrical installation which is meeting with ready sale. It is claimed to be superior to anything heretofore used and cheaper. Samples and prices can be had on application.

ADVERTISERS' HINTS

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., say their rheostats are doing their share to make Milwaukee famous for other things besides beer. The rheostats are good—so is the beer.

THE WORTHINGTON COMPANY, New York, wish it remembered that they make condensing apparatus for all known conditions of service.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburgh, Pa., call attention to the transmission of Niagara Falls and the St. Lawrence in which connection they refer to the 5,000 h. p. units installed by them in both plants.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, advertise power generators for railway or stationary motor service and illustrate one of their multipolar generators direct connected to an Imperial engine.

THE BOILER EXPURGATOR COMPANY, 115 Dearborn street, Chicago, Ill., cite an instance where the use of their boiler compound prevented the sale of a new battery of boilers as the old one improved so much after its use that the new one was not required.

THE WALKER COMPANY are advertising enclosed arc lamps for incandescent circuits.

THE DELAWARE HARD FIBRE COMPANY, Wilmington, Del., say their name is a guarantee of high quality, reasonable prices, prompt service and polite attention.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., will make special prices on annual contracts where the requirements equal or exceed 1,000 lamps.

BLAKE & WILLIAMS, steam and electrical engineers, 362-4 West Broadway, New York, make a specialty of the manufacture and design of high grade switch and panel boards.

WESTERN ELECTRIC COMPANY, Chicago and New York, have a word to say about "Simplex" friction tape. A sample roll may be obtained free.

HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., claim their switches to be the best and the cheapest.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. MARCH 17, 1898. No. 515.

ELECTRIC LIGHTING

The Dolgeville, N. Y., Electric Light and Power Plant.

THE greatest day in the history of Dolgeville, N. Y., was Saturday, January 15, 1898, when Hon. Timothy L. Woodruff, Lieutenant Governor of New York, turned the wheel which put into operation the power for the generation of electricity to transmit it far and near for lighting, heating and commercial and industrial aggrandizement.

Dolgeville, called "The Beautiful Little City at the Foot of the Adirondacks," is situated nine miles north of Little Falls, Herkimer County, N. Y., and about twenty miles from the city of Utica. This little city, bristling with enterprise and the spirit of industrial progress has now harnessed the rapid waters of the Auskerada, the erstwhile East Canada River, in order to run the looms and spindles in its mills and later perhaps the street car lines at Utica.

The rapid development of the city of Dolgeville is due largely to the efforts of Mr. Alfred Dolge, who controls a steam road between Dolgeville and Little Falls, owns felt factories and has a large interest in all the other various industries of Dolgeville. The population has increased from 200 in 1873 to 2,500 in 1897, and the property in valuation from $30,000 to $2,000,000. The population consists chiefly of Germans who are engaged in the manufacture of felt, piano sounding boards, and felt shoes.

The establishment of an electric plant for lighting and general power purposes greatly increases the efficiency of these various industries, and eliminates the smoke and other disagreeable features common to most manufacturing cities. This was recognized early in the history of Dolgeville, for in October, 1879, Mr. Alfred Dolge, ever and always in the front rank in the march of progress and improvement, at the very inception of incandescent lighting purchased and installed in his factory a 400 light generator, one of the first machines made in the United States, the number two of Thomas A. Edison, at present doing its work in the old power room of the Dolgeville Electric Light and Power Company, with an output of current for 800 lights, double its rated capacity.

As the manufacturing plant of Mr. Dolge increased, other generators were added and the citizens of the village were supplied with a cheap and efficient light service, thus early marked as a progressive community. In the year 1891, the Dolgeville Electric Light and Power Company was incorporated with a capital stock of $25,000, purchasing the plant of Mr. Dolge, and supplementing the light service with a service of power to all the manufacturing establishments of Dolgeville.

FIG. 1.—THE HIGH FALLS DAM WITH A PORTION OF THE FALLS IN THE FORGROUND. THIS PICTURE SHOWS A DEPTH OF 5 FEET OF WATER AT THE OVERFLOW.

Notwithstanding the low rate at which light and power has been dispensed here, a condition due to the small cost of initial power, the water, the company has been a commercial success. The net earnings on the capital stock of the company since its organization have been as follows:

	Per cent.
For the year 1892	10
For the year 1893	15
For the year 1894	22
For the year 1895	18
For the year 1896	22
For the year 1897	21

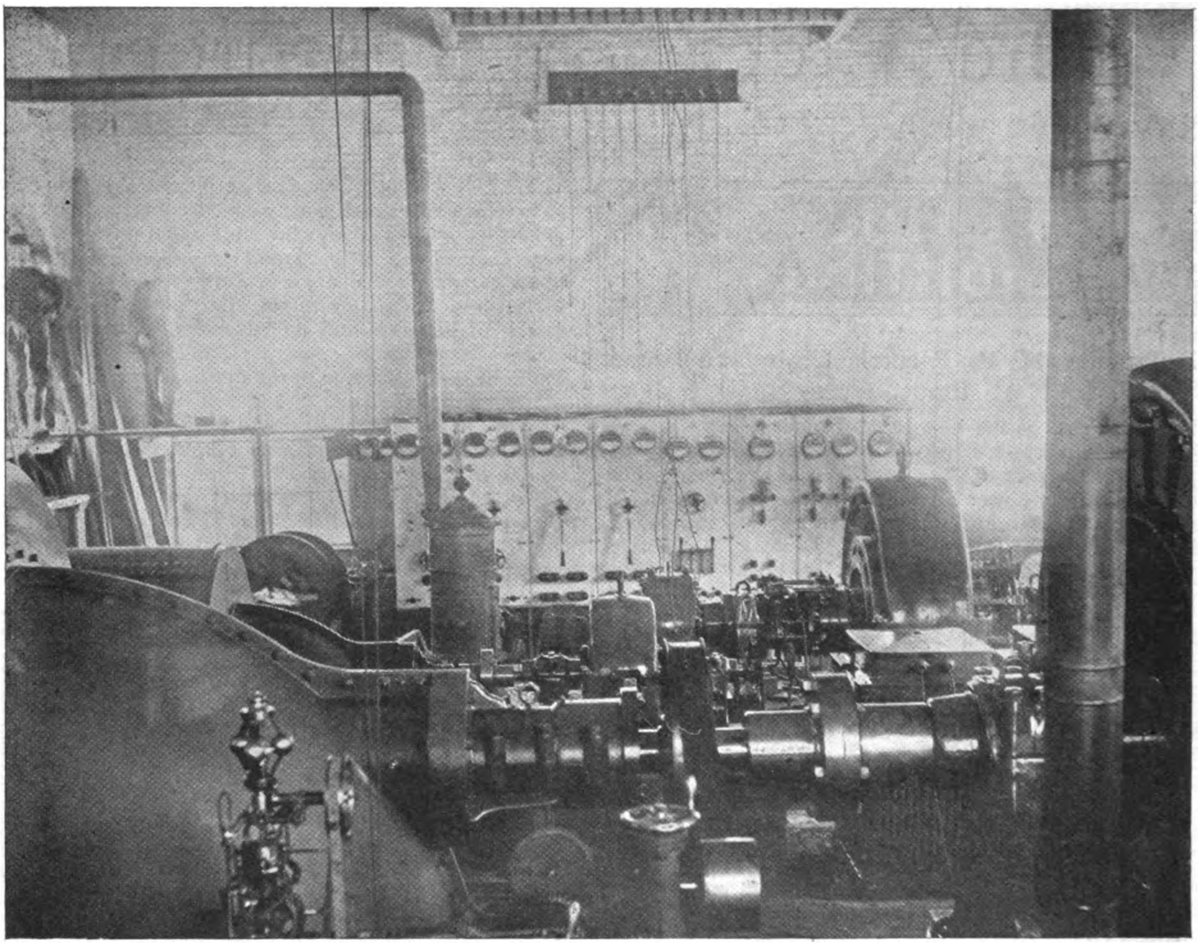


FIG. 3.—INTERIOR VIEW OF THE POWER HOUSE AT HIGH FALLS, DOLGEVILLE, LOOKING FROM THE ENTRANCE TOWARDS THE SWITCHBOARD.

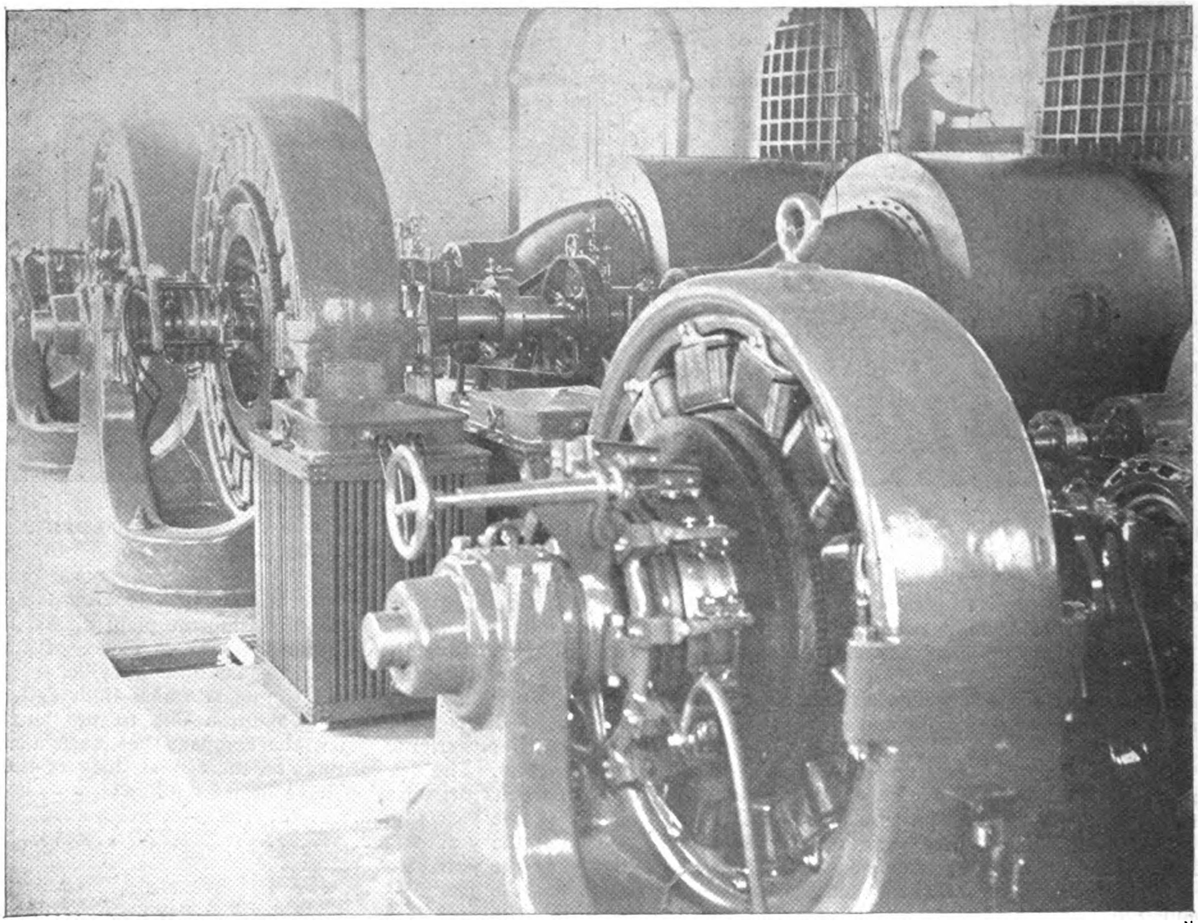


FIG. 4.—INTERIOR OF POWER HOUSE AT HIGH FALLS, DOLGEVILLE, SHOWING TRANSFORMER, GENERATORS AND WATER WHEELS.

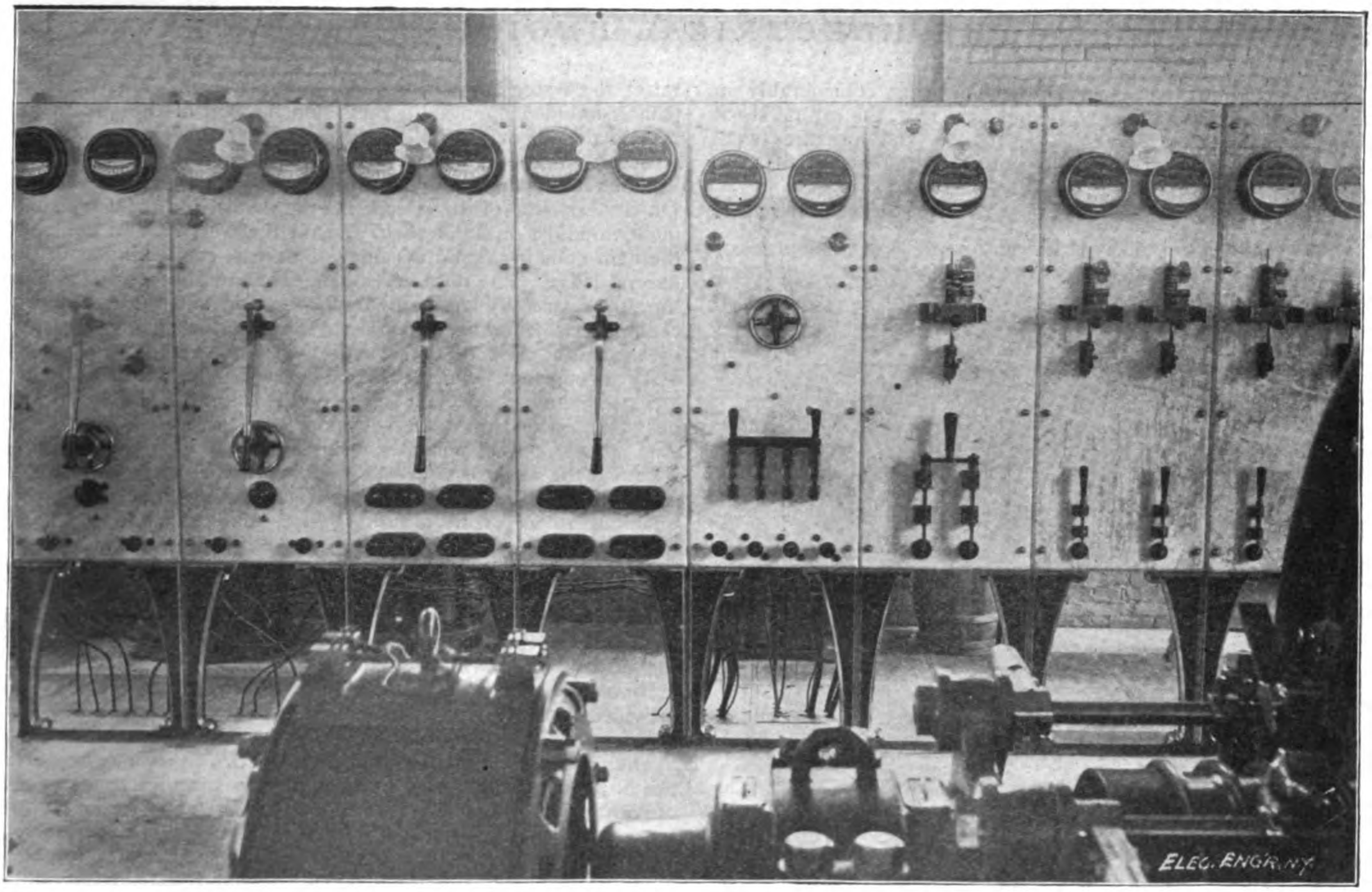


FIG. 5.—MAIN SWITCHBOARD, DOLGEVILLE ELECTRIC LIGHT AND POWER STATION.

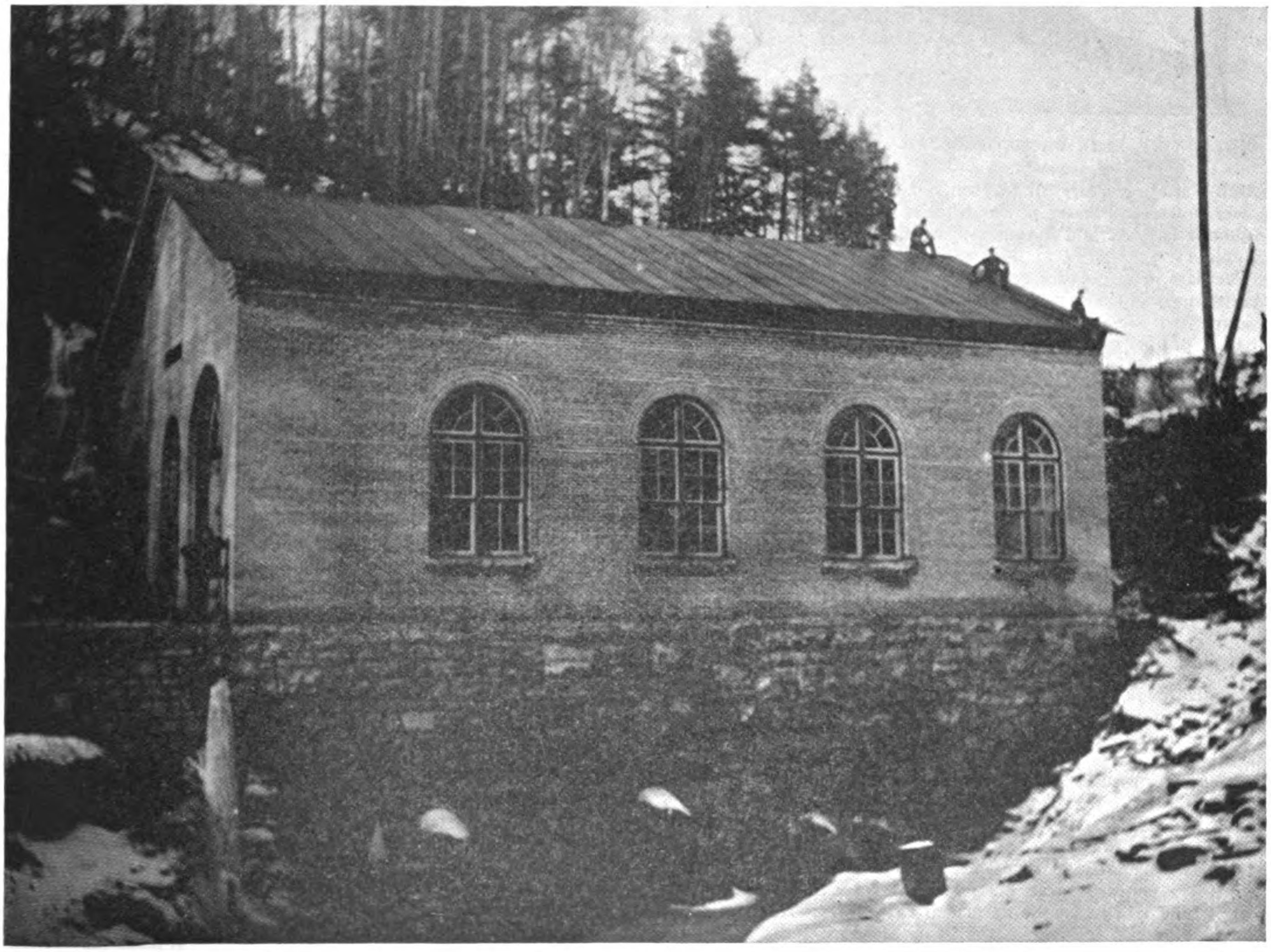


FIG. 2— POWER HOUSE OF THE PLANT OF THE DOLGEVILLE ELECTRIC LIGHT AND POWER CO. AT HIGH FALLS.

The demand for power in Dolgeville being considerably in excess of the ability to supply, in January, 1897, the capital stock of the company was increased to $100,000, and measures were taken to develop the High Falls power to the extent of 1,200 h. p. minimum.

Contract was made in May, 1897, with Stilwell-Bierce &

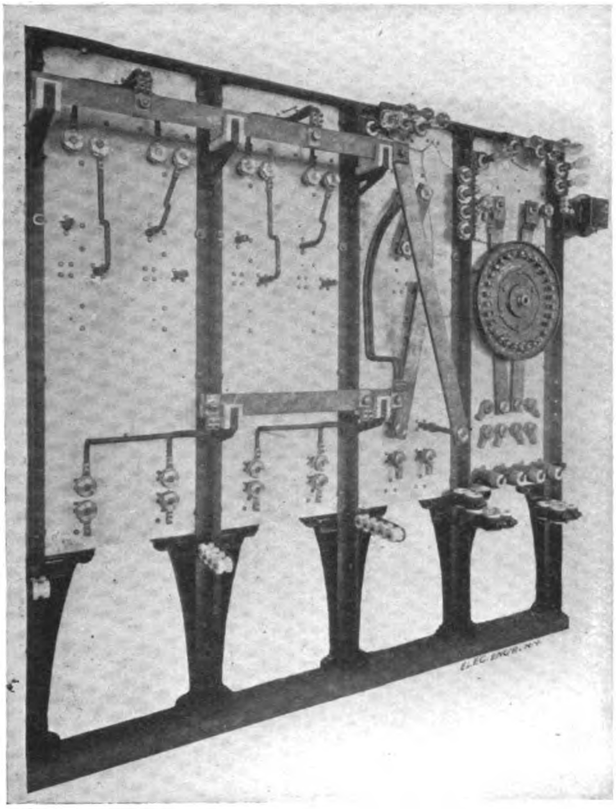


FIG. 6.—ONE END, BACK OF DOLGEVILLE SWITCHBOARD.

Smith-Vaile Company, of Dayton, O., to erect the dam, feeder, power house and water power wheels, etc., and with the Westinghouse Electric and Manufacturing Company for the electrical machinery.

The dam, gates, feeder and water supply, are constructed for a maximum of 3,500 h. p. The water wheels for present minimum use are two Victor wheels of 750 h. p. each, and a small wheel of 50 h. p. operating under a head of 72 feet. The water wheels, controlled by electric governors, are direct connected with two 600 h. p. each Westinghouse two-phase alternating current dynamos, 7,200 alternations 300 r. p. m. generating at 2,400 volts.

Power is transmitted to Little Falls upon three wires at a potential of 10,000 volts, and there reduced to a voltage of 2,200, for supply to motors by converters at any voltage desired.

After giving this brief history of this very interesting power development let us return to the source of power, the High Falls of the Auskerada River. This river takes its rise in the western section of the Adirondacks and is supplied in its course from small lakes, probably numbering nearly a thousand.

The development of a water power of the magnitude of this undertaking called for more careful thought and thorough study than would at first be apparent to the casual observer. Early in 1894 the Dolgeville Electric Light and Power Company, recognizing the high class talent employed by the Stilwell-Bierce & Smith-Vaile Company, arranged to have their Mr. A. C. Rice, chief engineer and general superintendent, make an examination of the proposed development, and to his examination, recommendations, plans and specifications, which have been faithfully followed, the splendid results now in daily evidence, are due.

Active operations were begun in May, 1897, and the work has been constantly prosecuted since that time, under the direction of the engineers of the Stilwell-Bierce & Smith-Vaile Company. The work may be described as follows: At a point approximately 100 feet above the brow of High Falls a masonry dam has been constructed, shown in Fig. 1, the crest of which raises the water 20 feet above its natural level. This masonry dam is founded upon solid rock, and the bed of the stream has been grooved, or dovetailed, in order that the masonry superstructure might not only rest solidly upon the foundations, but that the dam should be absolutely watertight at the base. On the east side of the stream the dam ends in a masonry abutment, founded on solid rock, and on the west side of the river the dam ends in a solid masonry abutment, connecting with the natural ledge. The masonry in the dam and abutment is a blue limestone carefully laid in hydraulic cement, and the recent successful tests from the unexpected floods give strong evidence of the high class of construction that was employed in the work throughout. Out of the abutment on the west side issues a waste gate of sufficient capacity to drain the pond for any necessities which may later develop. To the west of the waste gate a 10-foot steel penstock originates, and it is through this tube that the water is conveyed to the power house, a distance of approximately 500 feet. This penstock is supported at intervals of about 16 feet with masonry piers, founded upon the solid rock bed of the stream.

The power house, shown in Fig. 2, at which point the water is received, is situated in a canyon between two high cliffs and is founded upon solid rock and built substantially of stone and brick, all laid in cement mortar. It is ultimately expected that the power house will be extended beyond its present size, to accommodate the installation of 3,000 h. p. The power house is provided with steel roof and concrete floors, making the building practically fireproof.

The present installation consists of two Victor wheels of 750 h. p. each, which may be seen in Fig. 3, and a small wheel of 50 h. p. operating under a head of 72 feet. The water wheels are controlled by electric governors and are direct connected to the generators without flexible couplings. Each of the turbines is provided with an independent water gate, controlling the admission of the water to the wheel, so that in the event of any accident to either wheel the troubled apparatus can be examined without shutting down the plant.

The electrical equipment was supplied and installed by the

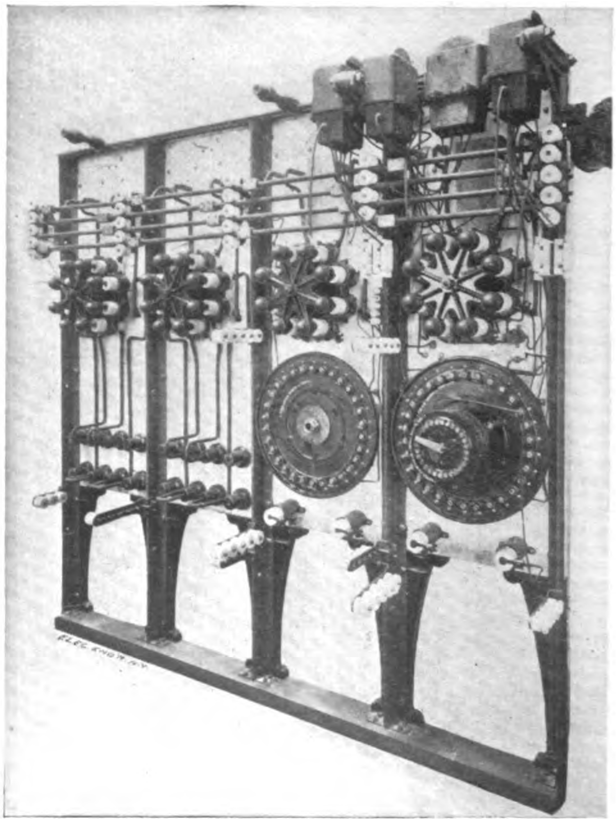


FIG. 7.—ONE END, BACK OF DOLGEVILLE SWITCHBOARD.

Westinghouse Electric and Manufacturing Company, and consists of the following apparatus:

Two 450 k. w. 7,200 alternations, 2,400 volt, 300 r. p. m. two-phase generators, direct connected to the water wheels, shown

in Figs. 3 and 4. One 15 k. w. 100 volt, multipolar exciter, direct connected to the smaller water wheel spoken of above. Two 250 k. w. 10,000 volt raising and two 250 k. w. 10,000 volt lowering transformers. One 250 k. w. revolving rotary transformer, 7,200 alternations, having a maximum potential of 600 volts. Two 150 k. w. lowering transformers and an eight panel switchboard for the generators, feeders and rotary, a front view of which is shown in Fig. 5. The back connections of the right hand direct current portion are shown in Fig. 6, and those of the left or alternating current portion in Fig. 7. In the latter figure will be seen the transformers and also the backs of the new Westinghouse high potential, quick break, plunger type switches, shown in detail in Figs. 8 and 9. These switches were designed and built on the principle that (1) an arc is maintained with difficulty when the circuit is quickly broken, (2) an arc tends to expand, it cannot therefore be readily maintained in a confined space, (3) an arc cannot withstand a strong transverse draft of air. The switches break the circuit quickly and in the case of the heavier currents, at two places in series in each side of the circuit, thus dividing by two the pressure at the breaking points. The break is made in a small enclosed air chamber, thereby limiting the expansion of the arc, and also by means of such expansion creating a strong lateral draft of air through a vent provided for that purpose and thus supplying the third and remaining requisite for a ready suppression of the tendency to arc. Similar switches have been used in the Niagara Power Company's plant in Niagara Falls, and it is claimed that with them it is perfectly practicable to break the lagging current of a 2,200 volt two-phase 5,000 h. p. generator fully loaded and without any sparking or burning of contacts whatever.

The Westinghouse generators are of the inwardly projecting field type, the armature being the revolving element, and are operated in multiple. The machines are excited by one 15 k. w. 100 volt multipolar generator, which is ample for both alternators.

The voltage of the rotary can be raised or lowered from 500 to 600 volts without shutting down the machine. Mechanically the rotaries are of the same general design as the generators, having horizontally split fields, etc. Electrically they consist of a Westinghouse alternating current motor and a Westinghouse direct current generator. A small starting motor is mounted on the end of the shaft.

The two-phase generators, which require four cables for transmission, by conversion into three-phase in the step-up transformers three cables only are required to form the line. This method, known as the Scott two-phase-three-phase system, saves 25 per cent. in copper and the same amount in the number of insulators needed.

The power is transmitted to Little Falls at a potential of 10,000 volts. It is there reduced by step-down transformers to 2,200 volts, and is then distributed to various other reducing transformers conveniently located for power purposes. The power is used for operating two-phase motors in a number of knitting mills and machine shops in Little Falls, and for lighting and operating direct current motors at Dolgeville. It is the intention of the company to equip all new factories with induction motors, and to gradually replace the direct current motors with motors of the induction type. It is further proposed to operate the steam road between Little Falls and Dolgeville by electricity.

In conclusion we venture to say that this is the beginning of an improvement of this locality for power, which is destined to be far reaching in its results to the manufacturing interests of the Mohawk Valley. Within five miles above and below the village is a total fall of 412 feet which can be utilized in seven plants, which when grouped and supplied with electrical machinery will furnish a steady and constant 20,000 h. p.

We are indebted to the "Dolgeville Herald" and the Westinghouse Electric and Manufacturing Company for the above data and illustrative material.

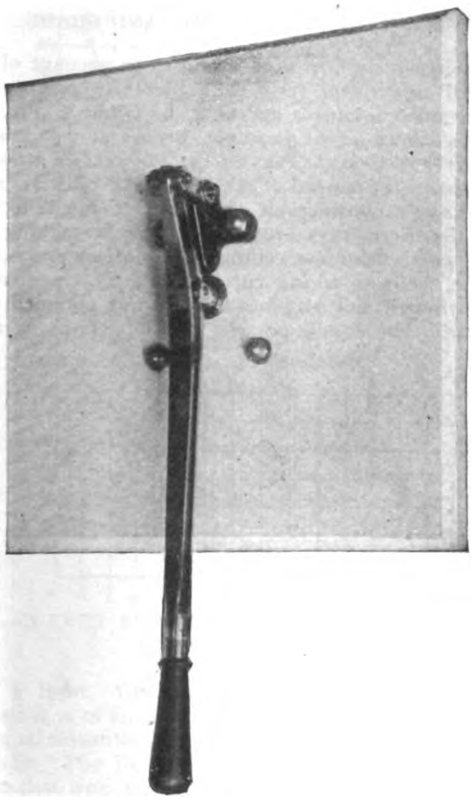


FIG. 8.—FRONT VIEW.

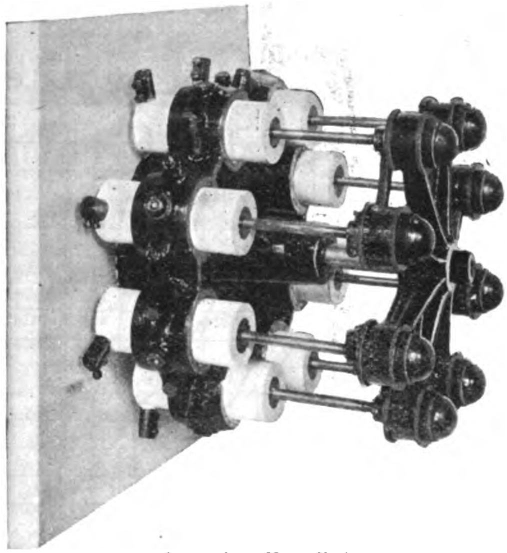


FIG. 9.—BACK VIEW.

FOUR-POLE DOUBLE BREAK SWITCH FOR TWO-PHASE CIRCUITS.

Experiments in Room Illumination.

BY I. C. THOMPSON.

WHEN the query arises as to how well a room is lighted, the answer usually is either brilliantly, very well or poorly, the estimation of each of these gradations being left to the individual judgment alone. It is the same with heating and ventilation. The writer never has seen a specification for any building specifying the foot-candles of illumination, degrees of temperature or the hourly percentage change of air. True, these factors may vary greatly, but not so when standard conditions are also given. There is great room for development in this direction, having for its main object definiteness, so that each room will have the above factors closely specified in definite units just as the steel or cement entering into construction is specified.

It was required to determine whether a small room, Fig. 1, was sufficiently lighted by means of a central, pendant, 16 c. p. incandescent lamp, and the force of the above remarks became at once apparent. One lamp was used in this room and but one was used in rooms twice the size, the former, of course, being the more brilliantly lighted, but not necessarily sufficiently, the latter being the point under determination. According to Siemens, a floor space of five square feet per candle or 80 square feet for the 16 c. p. lamp is sufficient; this room has an area of

$9 \times 14 = 126$ square feet, and would therefore require a 25 candle illumination, such as is given by a five-foot gas burner using New York City gas. Uppenborn gives five to seven square feet, the latter allowing a 112 square foot room. Kermanner and Prausnitz state that 0.73 to 0.83 foot-candles (horizontal) illumination is sufficient for all ordinary purposes, and that 0.90 to 0.95 foot-candles are sufficient for readers and

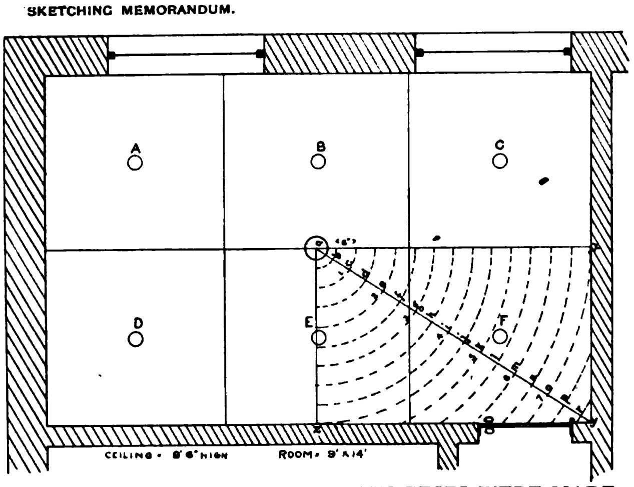


FIG. 1.—PLAN OF ROOM IN WHICH TESTS WERE MADE.

writers, while Cohn recommends about one foot-candle. The latter is seldom attained in practice by means of general illumination, separate lamps being supplied each individual, as in libraries, or private tables and desks, and here the illumination may become twice this amount.

Following the method of blocking out an area to arrive at the average illumination and making the tests at the centre of each square, it was found that the results obtained were undoubtedly too low. These, and all subsequent tests were made with the top of the photometer box horizontal and 30 inches above the floor, the lamps being four feet above this in all cases but two, which are so designated. These were the results obtained with a 16 c. p. lamp:

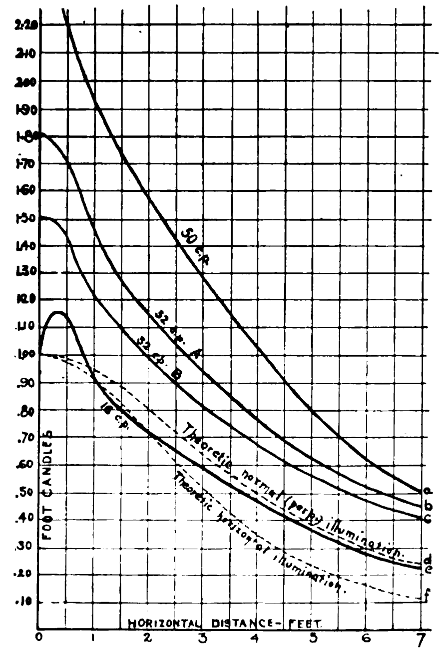


FIG. 3.—CLEAR GLASS BULB.—POSITION I., FIG. 2.

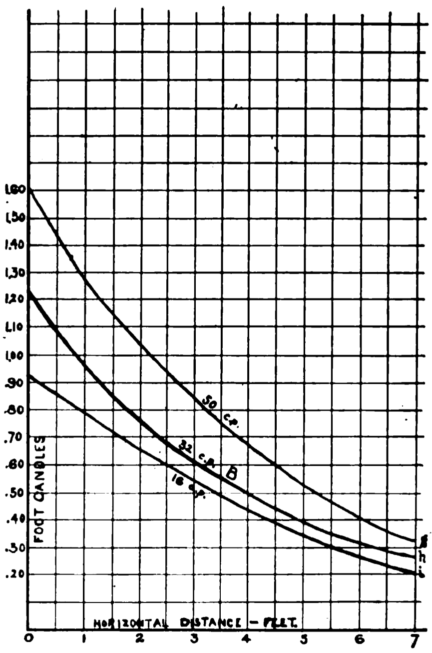


FIG. 4.—CLEAR GLASS BULB.—POSITION II., FIG. 2.

Location of points of observation.	A	B	C	D	E	F	Mean.
Naked bulb	.23	.75	.20	.20	.70	.20	.38
Fluted shade directed downward	.32	1.10	.23	.25	1.10	.25	.54
Fluted shade inverted	.19	.47	.20	.19	.43	.20	.28

As this method was not satisfactory it was decided to construct the theoretic curve giving the illumination at successive horizontal distances, considering first that the effect varied inversely as the square of the distance from a point of light for normal illumination, and directly with the sine of the angle the light ray makes with the horizontal for horizontal illumination. These two curves are shown as d and f, Fig. 3. The effect of inclining surface to the light ray is therefore very marked.

Tests were then made along the lines ax, ay and az, Fig. 1, and the illumination for equal distances found not to vary much

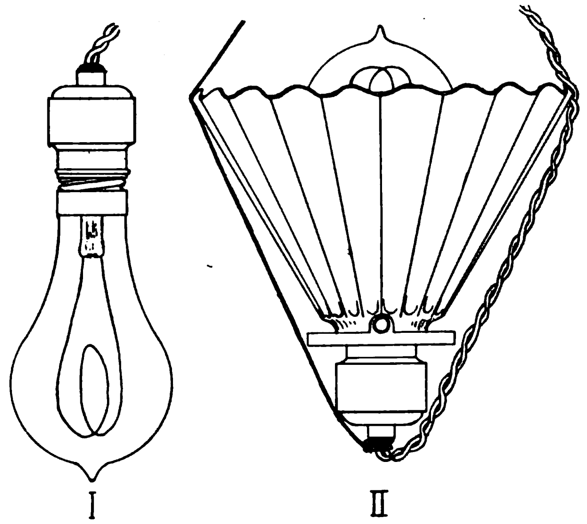


FIG. 2.—POSITION OF LAMP AND SHADE.

except to increase slightly near x and z, on account of wall reflection. All subsequent tests were therefore made along ay. From the results obtained, curves a, b, c and e, Fig. 3, were constructed. Curve a, for example, begins at 2.50 and should theoretically drop to $0.12 \times 25 = .30$, whereas it drops to .50; curve b drops to .45 instead of .22, and curve c to .41 instead of .18. This shows a considerable amount of ceiling reflection. In fact, when the direct rays are screened off in making curve i, Fig. 4, 0.18 came from the ceiling at three feet and 0.16 at six feet distance, while in taking curve m, Fig. 5, the shade being directed downward, but 0.03 foot-candles was obtained from the ceiling alone. The candle-powers of the lamps were those marked upon them by the makers; a crude test showed them to be approximately correctly marked; this point is immaterial, as it was distribution rather than intensity that the tests were made for. Curve c here had an average of 57.8 foot-candles. As the candle power becomes higher the curve becomes more regular, indicating greater diffusion, possibly.

It was suggested by Kermanner and Prausnitz that conical shades be inverted, transmitting part of the light and reflecting the remainder into the ceiling. It was accordingly decided to see what effect this would have upon the curves, as the shade in Fig. 2, position II., was tested with the results seen in the curves of Fig. 4. The illumination was reduced thereby about 33 per cent. for the 50 c. p. lamp; 25 per cent. for the 32 c. p. lamp, and 10 per cent. for the 16 c. p. lamp. The effect, however, was admirable and eminently adapted for room illumination, although the average for 16 c. p. was 0.52 foot-candles; the light was soft and noticeably easy on the eyes, more so than ground glass. Opal shades are, however, made too thick for this purpose, and cut off more light than is necessary. The less difference there is in the brightness of adjacent parts, the easier the light is upon the eyes; this, of course, renders it necessary to screen the light source, and at the same time adjust the light coming through the shade and from the reflecting surfaces, such as a ceiling, so that the brightness shall be as uniform as possible—a solid mass of light. By properly shaped opal reflector-shades the curves in Fig. 4 could be still more flattened, especially if the ceiling is white.

Still other tests, plotted in the curves of Fig. 5, were made which show how great an effect the kind and position of a shade

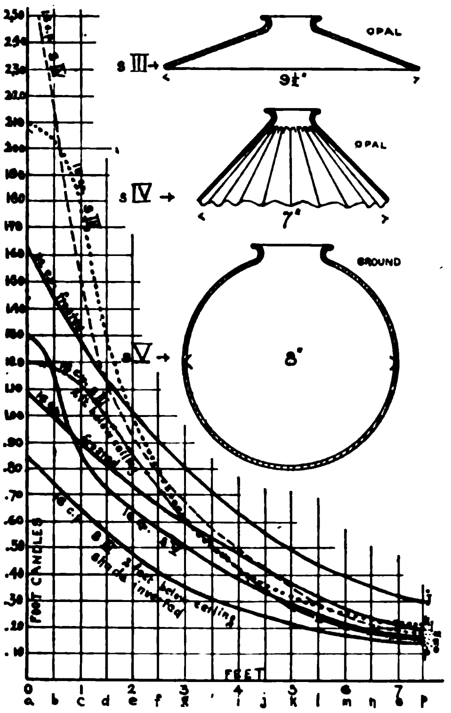


FIG. 5.—CURVES SHOWING THE ILLUMINATION WITH VARIOUS SHADES.

has upon a light. Curve m gives greater illumination than curve i, but it is of an entirely different quality; it is too harsh. The principal advantage of the ground glass shade V., curve n, is its beauty. The light from ground glass does not seem so pleasant as that from opal shades, but the effect of a large sphere of light in a room is decidedly more artistic than a clear glass bulb. For the general illumination of Columbia University Library these spheres, enclosing 16 c. p. lamps, are used both suspended and supported by columns, while a seven-foot sphere suspended in the dome is rendered luminous by the projected rays of eight powerful arc lamps.

Shade s III., Fig. 5, is a good downward reflector, but a poor diffuser, being not nearly so good as the inverted s IV. Shade s V. was suspended from a pulley so that it could be raised to the ceiling out of the line of sight, where it gives .75 foot-candles, or lowered within two feet of the table, giving in the latter case an illumination of 2.6 foot-candles upon the table; thus, when reading or writing are in order, the globe is lowered, and again raised to the ceiling when an intense light is not required. These globes can be stained yellow, orange or rose by colored solutions washed upon their interiors; a rich cream color, however, being preferable. Numerous other combinations will at once suggest themselves.

It does not pay to put up with the discomforts and possible injury to eyes incident upon the use of naked lights of any kind. This is evident with the now popular Welsbach lamps, which are almost invariably inclosed by shades of some sort for interior illumination, and these shades add considerably to the ornamental character of a room. If electric companies would take equal pains to make the incandescent light pleasant and ornamental, the results would no doubt soon be manifest in increased earnings. The fact is, that in the past year, small and large stores have sprung up in every locality which handle Welsbach shades of highly ornamental design, whereas it was only after considerable trouble that a store could be found where the shades used in these tests could be obtained.

It is probable that the best shade for diffused lighting would be an inverted conical glass shade with straight sides, having an angular opening of about 90 degrees, ground on the outside so as to transmit more light than an opal shade, and reflect the remainder up against a light colored or preferably white or slightly tinted ceiling, and of such a size as to conceal the bulb itself. This would probably give the highest results per lamp in comparison with other diffusion methods.

It scarcely pays to use a 32 c. p. lamp or one of higher power. It would seem better to be able to raise and lower the bulb to obtain a desired brilliancy; certainly 2.6 foot-candles is enough for reading, and a mean general illumination of 0.5 foot-candles for other purposes, and both these can be had by raising and lowering a 16 c. p. lamp in a spherical ground glass shade. Ground glass bulbs give good illumination results, but are still quite intense when looked at. The diffusion surface is not large enough.

These tests are relative. There was considerable variation in results at various times, showing that the current varied; the candles differed in quality, and the lamps decreased in intensity. The comparative figures on the same curve, however, are accurate, and it is this point which was to be determined.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—I.

BY A. E. DOBBS.

PITFALLS IN STARTING.

THE rapid growth of independent telephone companies in the past two or three years has led to numerous and costly experiences on the part of some of their owners, many of whom having spent their lives in other pursuits, and having but vague and uncertain ideas on the subject of telephone construct.on and management, frequently acquire their knowledge at a price that would build a plant of twice the capacity of the ones they now possess. Many exchanges are equipped without regard to future, or even present needs, an increase of business necessitating a partial or entire rebuilding of the plant, and rebuilding is costly.

As a general thing the building of a new exchange proceeds something after this fashion: A canvass of the town is made to secure the necessary number of subscribers, and sell stock. It is successful. When the capital has been secured, the question comes as to how the plant is to be built. Most of the men who furnish the capital know nothing of the business. They often send a committee off on a junket to visit one or two exchanges built by people as ignorant as themselves, and said committeemen come back with the idea that they know how an exchange should be built. An experienced concern would employ a competent engineer to make plans and estimates and superintend the construction of the work, but a new and inexperienced company with a calm confidence born of ignorance, in nine cases out of ten regard this as a useless expenditure, because there are any number of contractors willing to furnish them all the plans they want free of cost; and the idea is firmly rooted in their minds that the contractor will do the work much cheaper and better than they can do it themselves and in this they are partly right if present needs only are considered. Remember, however, the contractor must have his profits; he has to live. A number of contractors bidding against each other will offer to

put in a certain number of telephones for a certain price, an amount which will probably be less than an engineer's estimates, and lower than really good work at a reasonable profit demands. Now, the successful contractor may be a man who has followed railroad work, or cellar excavations, or electric railroad work, but even a telephone contractor with an ordinary conscience will not do any more work than the plans call for; especially if sharp competition has cut the price down to the last notch.

Well, the exchange starts out in business and if fairly well managed the lower rental charged increases the demand for telephones beyond all expectations, and the plant being totally inadequate to the demand upon it soon has to be practically rebuilt at a cost considerably higher than would have put in the entire plant in the first place. If not rebuilt, poles, lines and switchboard being overcrowded, poor service, constant interruptions and repairs, and in some cases bankruptcy, are the result. I know of two or three exchanges that have been almost entirely rebuilt three times in the last four years.

Nor can the original contractor be blamed for this state of affairs. It is not his place to tell owners what they should do, or what they should not do. Even if his advice was offered, he would probably be suspected of some ulterior motive, and his advice taken like dreams, by contraries. It might be, as sometimes happens, that he is himself a stockholder in which case he probably would do as well as he knew how, but it does not always follow that he knows how. Almost any contractor, however, prefers to get a reputation for first-class work, but if the owners cannot be made to understand what good work requires, he cannot be blamed for carrying out the plans or rather lack of plans, furnished him, and I even know of first-class construction men who have accepted plans under protest and put in work which they knew was inadequate. No real estate man would put up a building without consulting an architect, but a telephone plant which requires as much or more real skill for its construction and operation is often put in without plans or system.

Poor work in a telephone plant shows up worse than in almost any other kind of electrical construction; for where other circuits are numbered by a half a dozen, or even a score, of wires, telephone circuits are numbered by hundreds. There is not, I will venture to say, a power, or lighting pole line in the country carrying ten arms, and the only telegraph line I know of having anything like this capacity extends only a short distance from a Jersey City office. Yet in telephone work, ten or more arms on a pole is so common as to excite no comment whatever. Poles that will do for electric light and power or telegraph work, are of little use on such lines as these, and while it is true that arms and wires are lighter, yet the strain on the wires and poles is considerably greater in the aggregate.

Yet in contract work we often find poles with 4-inch tops carrying from 25 to 50 wires: and a badly buckled and disreputable looking line is the result.

In one plant of nearly 1,000 subscribers, the contractor put all his lightest poles on corners, perhaps under the impression that because two corner poles were close together, they did not need to be so heavy. Unanchored stubs were put down in a yielding clay soil to hold guys for corner and terminal poles carrying from one to two hundred wires. Junction poles were cross-armed in such a way, that the crossing wires became veritable crows' nests, making it almost impossible for a man to get to the top. Poles crossing other wires were not tall enough, and stringing wires along this line involved them in constant trouble with other companies.

Of course this plant has to be rebuilt in parts, and it was so badly mismanaged from the start, that many a contractor would be glad to build a better one at half its cost.

Nothing will drive away customers so quickly as a slouchy and bedraggled looking line, especially if the "old" company has been doing new work around the same town, to furnish a standard for comparison; for whatever may have been the faults of the old company in the past, its present work is done upon knowledge gained by 20 years' experience, and is of the most thorough and substantial character. People have the same prejudice against shabby looking work, that they have against a shabbily dressed man; and the only way to convince them that the "New company" has come to stay is to make the new work equal or superior to that of the older company.

I know of several exchanges that have almost doubled their subscription lists by rebuilding in the proper manner, and while rebuilding is expensive, because the work drags, for everything must be kept working, yet in many cases the added business has made it a profitable undertaking.

A man who engages to superintend the building of an exchange should be familiar with inside as well as outside work for often we will find exchanges equipped with good instruments, and poor outside work, and vice versa. Sometimes a contracting company makes a specialty of switchboards and will sublet the contracts for instruments and outside work. In many cases there is a disposition on the part of managers to look out for bargain counter instruments, though a brief experience is generally sufficient to convince them of this error. Others will try every make of instrument offered them, and get loaded up with all kinds, shapes and sizes, and so many different ways of wiring, that the hapless instrument man is driven to drink or worried into an early grave. The service carried on between bridged telephones and series telephones, high resistance and low resistance coils; bell magnets in series, shunted and cut-out; to say nothing of the different makes of transmitters and quantities of battery, becomes anything but uniform or desirable. But the men to be pitied are those who are loaded up with instruments purchased two or three years ago. It seems hard to have to throw away instruments that have only just begun to pay dividends, but if you are met by sharp opposition it will have to be done. Old instruments can often be worked off on small villages or private lines where they are looking for bargains and where the service is not exacting. Some managers desiring to get the best of everything will erect 40 foot poles where 25's would do just as well, buy heavy copper wire where No. 14 iron would answer every purpose, five cent insulators when those costing two cents would be amply sufficient, and in many other ways incur expense without regard to circumstances. That is simply a waste of money not justified by any prospective earnings; but to crown all, we sometimes see this material put up in a very inferior manner. If readers think this censorious or an overdrawn picture, a trip through the country will convince them that it is short of the actual facts. Of course in a discussion of this kind, names and places cannot be given, but two illustrations of working toll lines will suffice.

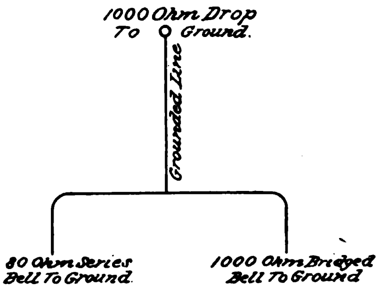


FIG. 1.

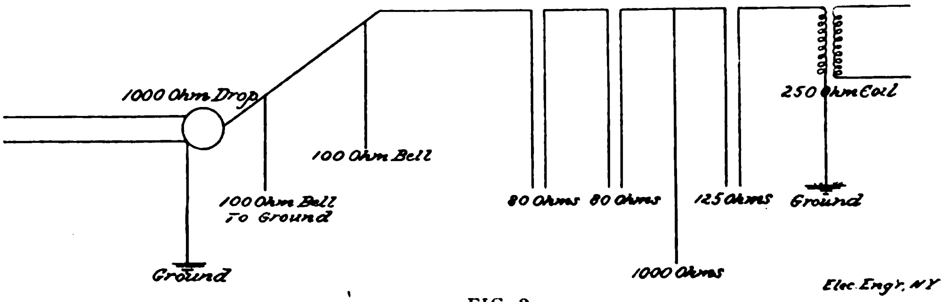


FIG. 2.

Fig. 1. The 1,000 ohm bell could not call "central" or be called from there. After some spirited correspondence with the manufacturer of one of the instruments, a 1,000 ohm bell in place of the one marked 80 ohms remedied the trouble. It does seem though that a manager who had the faintest kind of an idea of telephone work would know better than this.

Fig. 2. This is a diagram of a toll line in use not a thousand miles from Lake Erie, and the more it is studied the worse it appears, and yet these people actually expect to compete with the "old line" company for business in this section. It seems

to me that the Independent Telephone Association should draw up a standard set of specifications for toll line work right away.

In contrast with the above, I submit extracts from a manager of four years' experience which tells its own story. "We have put in one of the new —— —— —— switchboards. We are also buying the —— —— —— which I think is the best transmitter on the market * * * * We expect to build all our long lines full metallic and will use nothing but the best of everything. If the —— —— telephone is the best we can get, that is the one we want and no other, unless we can find a better one. I am all the time looking for improvements, and want this plant as perfect as the experience I have, and what I can buy of others, can make it." This manager will have to throw away quite a number of old instruments, but he has learned his lesson.

Before putting in your plant, employ a competent superintendent, one who has had practical experience in building, or managing exchanges. Give him carte blanche in regard to details; pay him salary enough to make it worth his while to devote all his time to the work, and have all your plans and estimates made before you start. Then, if you decide to let the work by contract, you will have something tangible for contractors to bid upon, and you will be surprised at the uniformity of the bids and obtain a high standard of work.

LETTERS TO THE EDITOR

The Diagrams in Book Form.

I send under separate cover a copy of a little book containing the report of the Chicago Electrical Association Committee on Standard Diagrams. In order to have these in concise and convenient form for the use of electrical draftsmen and patent attorneys, the Chicago Electrical Association has published this report in convenient pocket form, as it was believed that a majority of electrical engineers would wish to have a set of these diagrams for reference. To cover the expense of printing a nominal price of 10 cents each will be charged. Application for copies should be made to the writer. A mention of these facts in your columns would be appreciated by the association.

J. R. CRAVATH,
Secretary Chicago Electrical Association.
825 Monadnock Building, Chicago.

Exhaust Steam Heating.

Is it correct to let steam of 100 pounds and of 105 pounds pressure expand on the same curve when point of cut-off is the same, as in Mr. Thayer's diagram (Elec. Engr., March 10, 1898)?

Is it not correct, according to Zeuner's and Grashof's formula, that if by ¼ cut-off the back pressure is increased by 5 pounds, the steam pressure must be increased $1.7 \times 5 = 8.5$ pounds to get the same number of horse power?

Will not somebody who has an engine that turns out electric current increase its back pressure 5 pounds by a certain point of cut-off, note how much more steam pressure there is needed to carry exactly the same load, and give the result in The Electrical Engineer? J. S.

New York City, March 10, 1898.

The Selection of Electrical Engineering Diagrams.

IN your editorial of February 24 you give considerable credit to Prof. F. B. Crocker for his paper on conventional diagrams, the editorial being in reference to the recent publication of selected diagrams of the Chicago Electrical Association. It is well to give credit to those to whom it is due, and it is not the desire to lessen the importance of Prof. Crocker's work that the following résumé of the work is sent you:

Of the thirty-five diagrams published by Prof. Crocker only nine similar to those have been selected. On February 3, 1897, Mr. D. W. C. Tanner, who is actively engaged in work relating to electrical engineering and patent office affairs, read a paper, which was published by The Engineer. The reading of this paper resulted in the appointment of a committee whose instructions were to compile a set of diagrams which would bring uniformity into the preparing of patent office drawings and drawings of electrical engineering work in general.

With Mr. Tanner's paper as a basis to work upon, the committee examined numerous patent office drawings, submitted the diagrams in pencil to a number of men actively engaged in patent office work, received suggestions from the Patent Office and finally submitted the diagrams as they appeared in your issue of February 24. These diagrams were approved and adopted by the Chicago Electrical Association.

Mr. Tanner's paper gave a list of sixty diagrams, ten of which were duplicates. The diagrams submitted by the committee were fifty-seven, and of these fifty were diagrams representing with some modifications, the same apparatus that appeared in Mr. Tanner's paper; seven were new diagrams, one of which was a duplicate. Mr. Kempster B. Miller, one of the members of the committee, was for some years employed in the patent office and is an engineer of considerable reputation. Mr. C. Wiler is draughtsman and designer of electrical apparatus, and both had exceptional facilities to obtain expert criticism and suggestions for the work—and much credit should be given to these two gentlemen and to Mr. Tanner, as well as to Prof. Crocker.

In order that as much good and as wide circulation of the diagrams be obtained as possible they were given to the electrical papers before being published by the society. Since they have appeared in the various papers, the Chicago Electrical Association has issued them in pamphlet form, in a handy size for the pocket; which the secretary, Mr. J. R. Cravath, 825 Monadnock Building, will mail to any address upon receipt of 10 cents. The pamphlet is 32 pages, having every other page blank and six blank leaves in the back to permit the user either to make memoranda or paste in other diagrams which may interest him.

At the last meeting of the Association the committee were requested to continue the work of compiling standard diagrams, and any criticisms or suggestions or additions to the present list if forwarded to the secretary will be placed in the hands of the committee for action.

These diagrams represent another step towards a desired end, and by the co-operation of all who are interested the work can be further improved.

THOS. G. GRIER,
Chairman of Committee for Standardizing Conventional Diagrams, Chicago Electrical Association.
March 6, 1898.

The Northwestern Convention Trip.

I beg to thank you for the article in your issue of March 10, relative to the convention plan of the Northwestern Electrical Association. You are, however, mistaken in regard to the length of time involved in the trip and I fear that the article may mislead some who might take the trip when they understand that instead of three weeks' time from New York, both conventions could be taken in and return to New York made in about 12 days at the most. A little less than six days is the extent of the trip from Chicago to Duluth and return—three days on the steamer, two days at Duluth and one night returning from Duluth to Chicago. As it is only 24 hours between Chicago and New York, counting three and one-half days convention for the National and five and one-half days for our trip, two days between New York and Chicago coming and returning, this would make eleven days altogether. I think there are a great many people in the East who would take even two weeks' outing for such a trip, but who would probably not consider it if they were obliged to be absent from their business three weeks. J. M. HILL.

Chicago, Ill.

Paris Exposition of 1900.

Regarding the various government grants for the national exhibits at the Paris exhibition of 1900, the following figures may be of interest: The English Parliament has been asked for a preliminary grant of $375,000 to provide for the expenses connected with the British Section. The United States government had made a treasury estimate of $350,000. The German government has sanctioned a grant-in-aid of $1,250,000.

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Interior Illumination.

OF equal importance to the economical generation of the electric current and its distribution over the line is its proper utilization in the form of light, heat and power. The attempts to increase the efficiency of the dynamo by a fraction of one per cent.; to reduce the line loss by increasing the cross section of the conductors or by the employment of high potentials, are only too frequently counterbalanced, or their advantages annihilated by inefficient motor service, the use of cheaply constructed or poorly regulating lamps, or the uneconomical distribution of light. This latter fault has frequently had the effect of prejudicing the public against the use of the incandescent lamp, regardless of its numerous benefits, and it is high time that a prejudice, so unfounded and detrimental, should be removed. In making an experimental determination of this problem, the various conditions, which play an important part, such as size and height of room, color of walls and ceiling, the amount of natural light and the use to which the room is to be put, must be clearly stated; and the results may then serve as safe guides in determining the proper distribution. A series of experiments in this direction, of great value, has lately been made by Mr. I. C. Thompson, the data as to which we publish on another page in this issue. He reached the conclusion that a diffused light is by far the most desirable illumination for a room as it does away with the discomforts and possible injury to the eyes incident upon the use of naked lights of any kind. He further adds that the best shade for diffused lighting would be an inverted conical glass shade with straight sides, having an angular opening of about 90 degrees, ground on the outside so as to transmit more light than an opal shade, and reflect the remainder up against a light colored or preferably white or slightly tinted ceiling, and of such a size as to conceal the bulb itself. This would probably give the highest results per lamp in comparison with other diffusion methods. It scarcely pays to use a 32 c. p. lamp or one of higher power. It would seem better to be able to raise and lower the bulb to obtain a desired brilliancy; certainly 2.6 foot-candles is enough for reading, and a mean general illumination of 0.5 foot-candles for other purposes, and both these can be had by raising and lowering a 16 c. p. lamp in a spherical ground glass shade. Ground glass bulbs give good illumination results, but are still quite intense when looked at. The diffusion surface is not large enough.

Another very interesting and valuable investigation of diffused illumination was made lately by Dr. F. Kermanner and Prof. W. Prausnitz and are recorded in the "Progressive Age." While these experiments were made with Auer (Welsbach) gas burners, the results apply equally well to the incandescent electric light, namely: All downward light as well as the direct radiant heat should be cut off and the entire absence of shadows should be aimed at.

All the results seem to show, however, that diffused illumination is the correct and most agreeable method of interior lighting. Other experiments in this direction may further substantiate this assertion and result in the development of an efficient system of highly diffused light distribution. The lighting of the Columbia University library by means of diffused light from a seven foot sphere rendered luminous by the projected rays of eight powerful arc lamps, and its unqualified success, has already been very potent in making this method of illumination gain favor in this country. It devolves upon the manufacturer of globes and lamps to furnish the correct shape of bulb and globe and to produce an efficient lamp. On the other hand, it must remain the duty of every electric supply house to make the electric light pleasant and ornamental, and the results would soon be manifest in increased earnings of central stations.

Regulating Telephone Traffic.

LAST week we had occasion to comment on the grievance of a Washington doctor who had been made to get change for a large bill so that he could pay for a telephone connection, and who was in a great hurry. It was our endeavor to point out that no matter how urgent his case, the doctor would similarly have had to "split a bill" in order to prepay a letter or telegram, or to get a street car or elevated railroad ride. The incident was supposed to furnish an argument against the existing telephone service in Washington. We fail to see in it any thing but common sense business management. Here is another case of the same kind; a letter from "Syntax" in the New York Evening Post: "While telephone matters are under discussion by our lawmakers, it might be well to call their attention to a little method of extortion that might be checked. I refer to the custom of making a charge whenever a person is called up out of town, even if he is not in. For instance, I call for a man in Paterson, N. J. In a moment his office replies, 'Not in.' That ends the conversation, but I am charged 25 cents just as I would be if I had obtained the desired conversation and occupied the prescribed time. Intelligent management ought to put an end to this practice without appeal to the lawmakers." Possibly "Syntax" is a shrewd business man; perhaps he is unfamiliar with history. In the old postal days, of franks, it was a common trick to refuse a letter. Its mere presentation was all the news required by the person to whom it was addressed. Cannot "Syntax" see that it would be very easy to abuse the telephone system in the same way? How do we know that his friend's clerks were not advised that such a telephone call might convey certain information, without any interchange of words? Or how does "Syntax" know that his friend had not ordered his clerks to say in response to a telephone call, that he was not in? We all do it.

"Syntax" evidently expects—if he is honest in his complaint—that a system costing millions of dollars, employing hundreds of people, shall stand ready at his beck and call, and that if he cannot transact his business right off, the company must stand the brunt of it. How preposterous! Would he ask

a street car company to give him back his five cents, or a railroad company his 50 cents, if on getting to his destination, the man he wanted to see was out? Does he entirely forget the gain of time in reaching his Paterson correspondent? Let him go back to the means of the days when there was no telephone, or even let him stick to the telegraph. He would find that communication under such circumstances will be so slow and irksome, that he would soon want the telephone back, and would pay cheerfully twice the little fee asked for the service.

Combustion Efficiency.

IT has for some time been apparent that not a few electric light stations are earning dividends more as the result of small cumulative economies and stoppages of "leaks" than of any increased efficiency of apparatus. Indeed, this applies more to the steam than to the electrical equipment and the result has been that heaters, economizers, etc., are now very properly considered to be indispensable to economical operation. Unfortunately, however, the ratio of the well designed to the badly designed plants is still an appalling one, and any simple manner of bringing the latter up a notch or two will be welcomed. To reduce the coal consumption at its initial point, namely, in the furnace under the boiler, would seem the simplest way out. It is only too well known that much energy escapes in superheated gases which pass up the chimney accompanied by unconsumed gases, having calorific power, such as carbonic oxide, and hydrocarbon gases, not to mention the unconsumed carbon in the ash. To be calmly told, however, that all these losses can be avoided by closing the ashpit doors and drawing the air required for combustion down the chimney, will bring an incredulous smile to the face of most steam users. And yet the fact stands established beyond question that boiler furnaces are now being operated in this manner and with decidedly increased economy, according to reliable tests. The method by which this result is attained is described by the inventor, Mr. P. J. Schlicht, on another page, and will, we are convinced, excite the keenest interest on the part of every one operating a steam-driven electric plant. Whether or not the Schlicht system of combustion, in its present form, can be advantageously applied to every existing steam boiler may be open to discussion; but if the principle is correct, and there seems now to be no doubt on this point,—then it will probably be only a question of devising proper arrangements to apply it to every style of boiler now in use. For the sake of the entire electrical and steam industry, it is to be hoped that such will prove to be the case.

LITERATURE

AMERICAN GAZETTEER OF POWER PLANTS IN THE PRINCIPAL CITIES AND TOWNS OF PENNSYLVANIA FOR THE YEAR 1897. Cleveland, O., 1897. The American Gazetteer Company. 250 pp. 8 x 11 inches. Cloth. Price, $7.50.

This is a directory containing a list of power plants in all Pennsylvania manufacturing towns exceeding 5,000 population, census of 1890, together with the names of the manager, superintendent and chief engineer of each plant and detailed information as to the power used, number, style and horse power of engines and boilers, number of pumps, dynamos, elevators, etc. To this is added a directory of mechanical, electrical and consulting engineers, contractors and supply houses and other information of interest to power users and engineers.

In addition to the purely directorial contents we notice a chapter of "Useful Information, Tables and Suggestions," for power users; and one on "Electricity for Stationary Engineers." Both chapters are from the pen of Mr. E. P. Roberts, M. E., and contain a large amount of information in very compendious form.

ELEKTROTECHNIK. By O. Hoppe. Essen, 1898. G. D. Baedeker. 175 pages. 5½ x 8½ inches. Cloth. Price, $1.60.

This book is intended as an elementary electrical guide in connection with the machine, mining and smelting industry. It is unique in its presentation of the subject and has evidently been prepared with care and discrimination. The book is well adapted for technical as well as lay readers.

SOCIETY & CLUB NOTES

Chicago Electrical Association.

On the evening of March 4, the above Association discussed the Hunter patents issued December 21, 1897, on the use of transmissions employing alternating current transformers, about which so much interest has been aroused lately. Mr. A. Miller Belfield read a paper on the subject and this was followed by a discussion by Mr. W. Clyde Jones. The patents in question are Nos. 596,041, 596,042 and 596,002. The first one of these is a telephone patent in so far as the drawings are concerned. The second shows a constant current generator with interrupted circuit. The third shows an alternating current generator with step-up and step-down transformers. Mr. Belfield gave no opinion as to the validity of the patents but explained that they were as they stand infringed by every plant using transformers. In discussing the paper Mr. Jones threw some light on the commercial aspect of the case. Two of the patents (Nos. 596,042 and 596,002) are assigned to the General Electric Company. The other (596,041) was not and there was some question whether the claims of this latter could not be construed to cover the present field of alternating current transmission by means of step-up or step-down transformers.

Preparations for the Chicago N. E. L. A. Meeting.

In order to make proper plans and preparations for the Chicago meeting of the National Electric Light Association, President Insull called a meeting of representative electrical men of the Western metropolis, last week, to discuss the subject with him.

Announcement was made of the action of the association in naming June 7, 8 and 9 as the time for the meeting and selection of the Auditorium Annex, as headquarters. The fine banqueting hall has been secured for the sessions. Space will be furnished for exhibits in the hotel parlors and basement. There will be no general exhibit. President Insull announced that the plant of the Chicago Edison Company would be open to inspection at all times during the meeting and that every facility would be afforded members to examine the practical workings of the system. He said that the company would also afford facilities for manufacturers to display their apparatus and specialties in actual operation in the Edison station. The Chicago Edison Company will keep open house for the association during the convention, and the street railway companies and the elevated will co-operate with the lighting interests in giving the visitors an idea of the advancement that has been made in the electrical development of Chicago since the last meeting there. A visit to the drainage canal is proposed. Morning and evening sessions will be held, devoting the afternoons to entertainment and sight-seeing. No definite action was taken on any of the plans suggested, as it was deemed expedient to await the result of President Insull's conference with the Eastern officials of the organization. Another meeting of the Chicago committee will be held March 24, at which time the views of the Eastern members will be presented and definite action taken.

MECHANICAL

The Schlicht Method of Combustion.

By P. J. SCHLICHT.

THE progress made in electricity during the last quarter century has enabled many of the water powers of the world heretofore running to waste to be utilized to good advantage. But the fact remains that the limitations of economical transmission must for an indefinite period continue to leave the steam engine in undisputed sway as the prime source of mechanical power. This means, of course, that coal will be used as heretofore, and as statistics show, in constantly increasing amounts.

It is hardly necessary to enter into the discussion of the losses entailed in modern methods of steam generation. It seems, however, that of all the sources of loss that to which least attention has been paid is the loss entailed by the improper burning of the fuel on the grate. These losses may be stated broadly to be first those due to improper oxidation or combustion of the fuel, and, second, those due to the superheated gases escaping at the chimney.

In seeking to reduce and, if possible, entirely avoid one or both of these causes, I was led to the consideration that the prime source of furnace inefficiency was due to the introduction of cold air into the glowing bank of coal, in quantities far in excess of that required for the actual combustion of the fuel. How to introduce just the required quantity of heated air into the furnace was, therefore, the problem which I set before me.

Without going through a vast amount of preliminary work I may state at once that I discovered that a current of air and a current of combustion products will flow in contact without any substantial intermingling, and if a current of air is properly introduced into a chimney or flue through which hot products of combustion are escaping the current of air will flow to the place of combustion in a direction opposite to that of the current of products. The current of air will, however, gradually become hotter, while that of the products of combustion will gradually become colder. The heat thus imparted by the hot escaping gases to the colder entering air is thus utilized to advantage.

The general manner in which the plan above outlined is carried out in practice is illustrated in the accompanying engraving. As will be seen the top of the chimney is provided with a sleeve which extends for a short distance above and below the chimney structure proper. The hot gases pass out through the centre of the sleeve, while the air is drawn in between the inner wall of the chimney and the sleeve. The course of the two currents of inflowing air and escaping products of combustion are indicated by the arrows. Of course it will be understood that with the writer's system the ash-pit doors are kept constantly closed or nearly closed, all air necessary for combustion coming down through the chimney or by way of the chimney flue.

But there is another and most important advantageous feature connected with this method of combustion and that is, that the air supply is automatically regulated to that actually required for the oxidation of the carbon. This automatic regulation is the result of the interdependence of the actions of the chemical operations within the place of combustion and of the inflowing air and outflowing products of combustion. The intensity of combustion and the volume, temperature, density, and general conditions of the current of products of combustion are affected and governed by the like conditions of the air current, and the volume, temperature, density and general conditions of the air current are themselves directly affected and governed by the intensity of combustion and the volume, temperature, density and general conditions of the current of combustion products. The propulsive force is the pressure of the atmosphere, and since this pressure is practically constant the flow of air to the place of combustion will be in all particulars uniform unless there are variations in the general conditions of the column of escaping products of combustion within the stack or duct.

And now as to the practical results obtained with my system of combustion.

Various tests made with stoves convinced me that I had an invention of great value for the combustion of coal in ordinary domestic combustion appliances; many of the tests on stoves and furnaces showed from 33⅓ to 50 per cent. economy in the production of the same number of heat units available for heating or cooking purposes; but what its practical limitations might be when applied to steam boiler furnaces had yet to be ascertained. Such factors as size of chimney, area of grate and of heating surface, and kind of fuel, had all to be taken into account.

The first experimental application of this system to a steam plant was made at the Eastern Brewery, located at Meserole street and Bushwick avenue, Brooklyn. A contract was made on the basis of the saving effected, as shown by decreased consumption of coal per barrel of beer, before and after the application of the system. A careful and accurate account of the coal was kept, and a check was given in payment. Since this application of my method of combustion many improvements

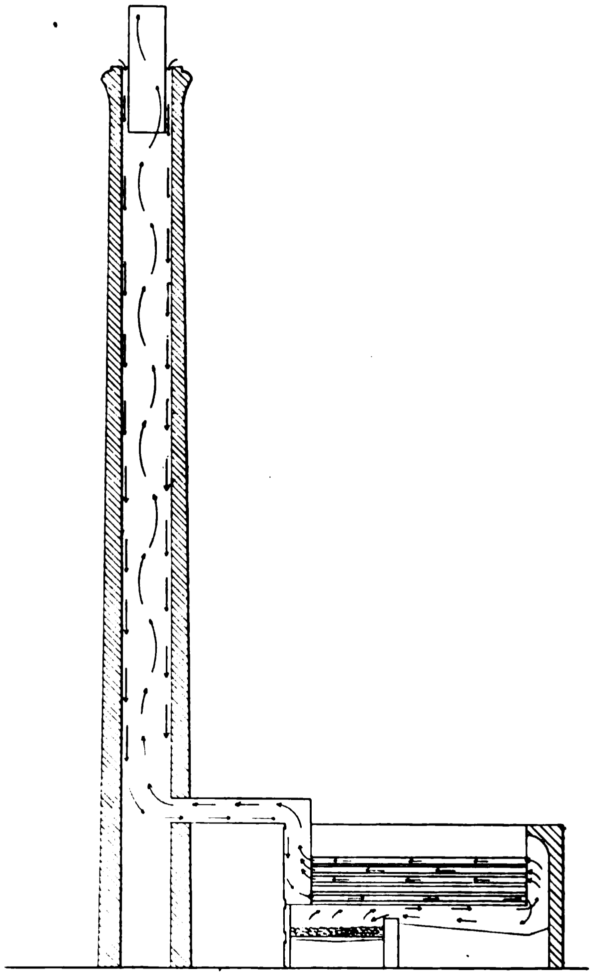


DIAGRAM SHOWING THE SCHLICHT METHOD OF COMBUSTION.

have been made, but the system still operates satisfactorily at this brewery. This was in May, 1896.

Careful evaporative tests were made, under the direction of skilled engineers, for the purpose of determining the real saving shown. The Schlicht Heat, Light and Power Company, that had acquired my patents, decided to carry on for a period of time a series of practical experiments on plants in actual operation, to ascertain the relation of different boilers and different fuels to the system.

Before proceeding any further with the history of the growth of this invention, I would briefly state what I claim to have found to be the salient features of the system, in its application to domestic as well as industrial plants.

First. A saving is made by heating the air by contact with products of combustion after they have passed the sphere of useful work, instead of heating the air at the expense of the fuel.

Second. A saving is made by feeding air heated by the pro-

ducts of combustion on top of the fire in automatically regulated quantities.

Third. A saving is made by excluding the large amount of surplus air fed through the grate bars in ordinary practice.

Fourth. Hydro-carbons and other combustible gases, which frequently escape before they are consumed for lack of oxygen, are wholly consumed in the combustion chamber.

The industrial value of different fuels is usually estimated by the amount of fixed carbon they contain. Our experiments, however, with coals high in volatile matter (which is a characteristic of the coals of the West), show that we are enabled to get a very high efficiency from them.

That calorimeter tests are unreliable in determining the industrial value of coals that have large percentages of hydrogen was shown in a paper read some time ago before the American Society of Mechanical Engineers, by Dr. Chas. E. Emery, in which he cited a coal that showed by calorimeter test some 24,000 heat units, but which in practice was not equal to a good Lehigh coal with half the heat units. Of course the percentage of fixed carbon in the former was quite low.

The results of several carefully conducted tests at Rochester, N. Y., under the direction of H. M. Reichenbach, engineer and chemist, with a coal having about 50 per cent. of volatile matter, showed a gain in evaporation of 44 per cent. This was at the plant of the Photo-Materials Company, which was selected by Mr. Reichenbach because it was a model plant. The significance of this test is obvious when we consider the great chimney wastes in connection with these fuels.

The following evaporative tests will give engineers some idea of the efficiency of the system in practice.

At the plant of the Barber Asphalt Paving Company, Long Island City, several carefully conducted evaporative tests showed the following results in evaporation:

	With Schlicht System.	Without Schlicht System.
Water evap. per lb. of coal from and at 212°.	12.96	10.79

An increase in evaporation of 20.1 per cent.

At the steam plant of the Hon. James B. Baxter, Portland, Maine, several tests were conducted with Pocahontas coal, as also with a mixture of one-quarter Pocahontas and three-quarter anthracite screenings, with the following results:

	With Schlicht System.	Without Schlicht System.
Water evap. per lb. of coal from and at 212°.	12.45	9.48

A gain of 31.3 per cent.

Burning the mixture of Pocahontas and screenings, costing \$2.08 per ton, as against \$3.80 per ton, a gain in evaporation was made of 3.2 per cent. over Pocahontas coal without the Schlicht system, or an economy in cost of coal per horse-power of 47.2 per cent. It was impossible to burn this mixture in this plant without the system unless forced draft were used.

At the Copley Square Hotel, Boston, it was impossible to burn pea coal and produce the required steam for an electric lighting plant that had been installed; consequently it was found necessary to burn Cumberland coal. With my system in use, the burning of three parts anthracite screenings and one part bituminous coal was made possible, with a saving to the proprietor of some \$200 per month.

A test made at Manchester, N. H., under the supervision of Capt. Chas. H. Manning, superintendent of the Amoskeag Mills, on the Manning boiler, using Reynoldsville coal, showed a gain in evaporation of 21.23 per cent. This was at the plant of Crafts & Green, shoe manufacturers.

Capt. Manning then selected the steam plant of the Langdon Mills, having a chimney too small for carrying off the products of combustion, the chimney having been built for two boilers, but to which three boilers more had been added. The tests were conducted by Prof. Lionel S. Marks, under direction of Capt. Manning and showed on a four days' trial an increase of evaporation in pounds of water from and at 212 degs. per pound of dry coal of 4.5 per cent. in favor of the Schlicht method.

Capt. Manning in a letter states that the chimney area was very small and that the plant was showing a very good efficiency before and that he did not expect there would be any beneficial results in this case.

A test taken at the steam plant of the distillery of Fleischmann & Company, showed a gain of 15 per cent. in evaporation, and at a subsequent test for capacity only, the Schlicht method developed a horse-power 8 per cent. in excess of the highest ever previously developed.

The above-mentioned are a few of very many tests that have been taken and are quoted as representative of the various types of boilers upon which the method has been tried.

Various experiments carried on demonstrated the fact that this system of combustion produced more heat than could be converted into useful work by the boilers. It required nearly a year of experimentation to obviate this difficulty.

The illustration given shows only one of the forms of application, as "deflectors" are applied not only at the top of chimneys, but as well in the horizontal flues and uptakes, the mode and place of application being wholly determined by the type and number of boilers, arrangements of flue and chimneys and other characteristics of the plant to be equipped. For house heating and other domestic purposes the flue application is almost exclusively used.

EDUCATIONAL

Electrical Engineering at Columbia University.

GENERAL PLAN OF BUILDINGS.

THE new buildings of Columbia University are located at 116th street, between the Boulevard and Amsterdam avenue, on the highest part of Morningside Heights, midway between Grant's Tomb and the new Episcopal Cathedral, commanding a view of the Hudson on the West and the Harlem River on the East. Thus situated in a great metropolis, the University secures the manifold advantages which that fact gives it, and at the same time is sufficiently lifted above the hurry and noise of the city to have the collegiate atmosphere. This effect is still further increased by the fact that the grounds between the various buildings form a plateau about twenty feet above the level of the grounds and streets outside of the group of buildings. By this arrangement great economy in space is secured, since it gives two more floors to each of the buildings situated around the edge of the plateau, their basements and sub-basements being above the level of the surrounding grounds.

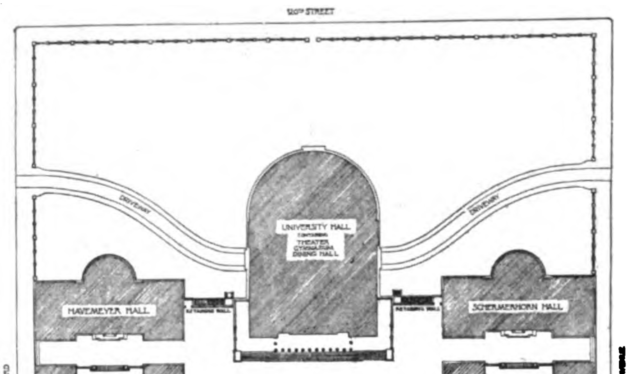


FIG. 1.—PLAN OF BUILDINGS.—COLUMBIA UNIVERSITY.

The raised level between the buildings also enables tunnels to be constructed which connect the various buildings with the central power plant in the University Hall. Through these tunnels all the steam and gas pipes as well as the electrical conductors are carried and the cartage of coal, ashes, and supplies takes place.

In this way these important practical matters are very conveniently carried on below ground as far as the college is concerned, but at the same time above the street level. Each building is provided with an elevator chiefly used for carrying apparatus and supplies to and from the various laboratories, lecture rooms, and museums. Thus it is an easy matter to transport even heavy apparatus from any room in the university to any other room. To still further facilitate this service, the door sills are entirely omitted in most of the rooms, so that a truck can be run about the buildings without jarring that which it carries, enabling apparatus to be arranged in the laboratory for use in the lecture rooms.

ment of Architecture is temporarily housed in the Chemistry Building, which has more than sufficient space for present needs. Schermerhorn Hall, the Natural Science Building, contains the Departments of Geology, Minerology, Biology, etc., and their extensive collections. The Physics Building, which also accommodates the Department of Mechanics and Astronomy, is designed and equipped according to the most modern methods for teaching and investigating physical science.

It is a striking fact, characteristic of modern tendencies, that all four of the new buildings, besides the Library and University Buildings which are used for general purposes, are devoted entirely to science; and three of them are especially important in their relation to Electrical Engineering. Hence the Course in Electrical Engineering at Columbia, which has already gained for itself a prominent position in electrical education in this country, has been materially benefited by the removal of the University to its new site. The principal improvements consist in a considerable extension of space and equipment in the Electrical Engineering laboratories, as well as in those devoted to Mechanical Engineering, Physics, and Chemistry.

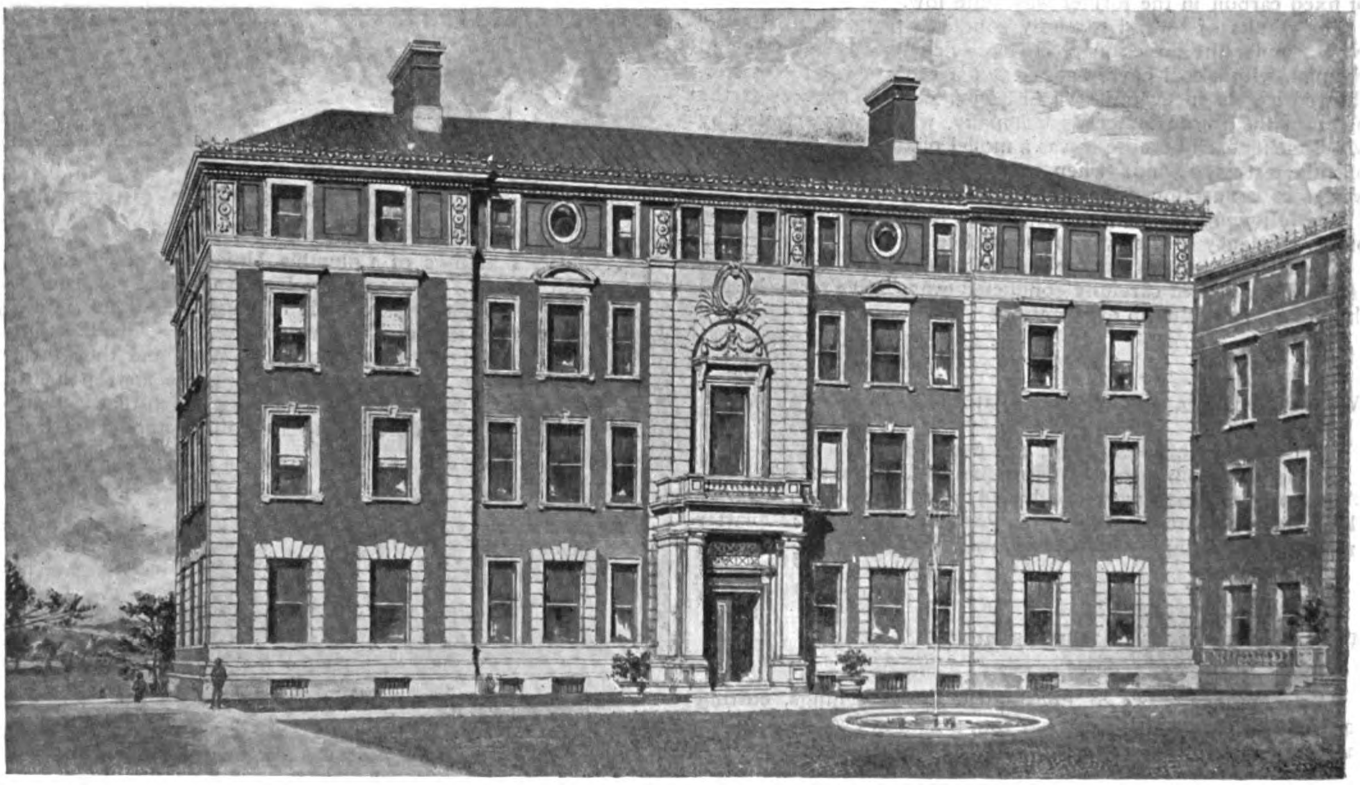


FIG. 2.—ENGINEERING BUILDING, COLUMBIA UNIVERSITY.

The location of the various buildings at the new site is shown in the general plan,[1] Fig. 1, the magnificent Library, presented by President Low, being the central one and easily accessible from all the others.

University Hall is the other general building, containing the power plant, gymnasium, academic theatre, etc. There are also four new buildings, respectively devoted to Engineering, Chemistry, Natural Science and Physics. Two old buildings will be used for the present by the Departments of Ancient and Modern Languages, and Mathematics.

The Schools of Law, Political Science and Philosophy are located in the Library Building, bringing them within convenient reach of the books upon which they are especially dependent. The Medical School will remain at Fifty-ninth street, between Ninth and Tenth avenues, where it is well provided with buildings and equipment. All the other departments of the University, including Barnard College and the Teachers' College which are affiliated with it, have removed to the new site.

The Engineering Building, Fig. 2, with its annex, contains the Departments of Electrical, Mechanical, Civil, and Mining Engineering. Havemeyer Hall, the Chemistry Building is the home of one of the largest and best equipped chemical schools in the world, having been designed by Prof. Chas. F. Chandler and the officers of his department after a careful study of the principal colleges and technical schools in this country and abroad. The Depart-

[1]Only those buildings designated by names are already erected.

THE ELECTRICAL ENGINEERING COURSE.

The regular four-years' course, leading to the degree of Electrical Engineer (E. E.) is designed for the education of professional electrical engineers who intend to devote themselves to the practice of this profession, either as teachers in colleges and scientific schools, or as engineers, managers, or experts in manufacturing or other industrial enterprises.

The course of instruction includes not only all important branches of theoretical and applied electricity, but also the other collateral sciences, which have been found by experience to be required by the electrical engineer, such as mathematics, physics, chemistry, drawing, analytical mechanics, mechanical engineering, including a thorough course in steam and other engines, as well as transmission machinery and shopwork. General engineering, including construction in masonry, iron, steel, and wood, also form part of the course.

Hence the graduate in the course in Electrical Engineering is provided not only with a thorough knowledge of the principles and practice of electricity, but also with such a broad and liberal education in the allied sciences as will prepare him for every demand that is likely to be made upon him in after life in connection with his profession, and will also enable him to become an investigator. The instruction is by lecture, recita-

tion, laboratory, workshop, and drawing room practice, wth periodical examinations. Special attention is given to new methods and forms of apparatus in order that the student may be brought fully abreast of the rapid progress of electrical science and practice. Frequent visits are made to the numerous electrical factories, stations, and other establishments in and about New York.

EQUIPMENT.

The offices, laboratories, lecture and other rooms of the Electrical Engineering Department are in the south end of the Engineering Building. In the sub-basement are located the storage battery and photometer rooms; the former contains a battery of 70 cells, to be used for efficiency and output tests and

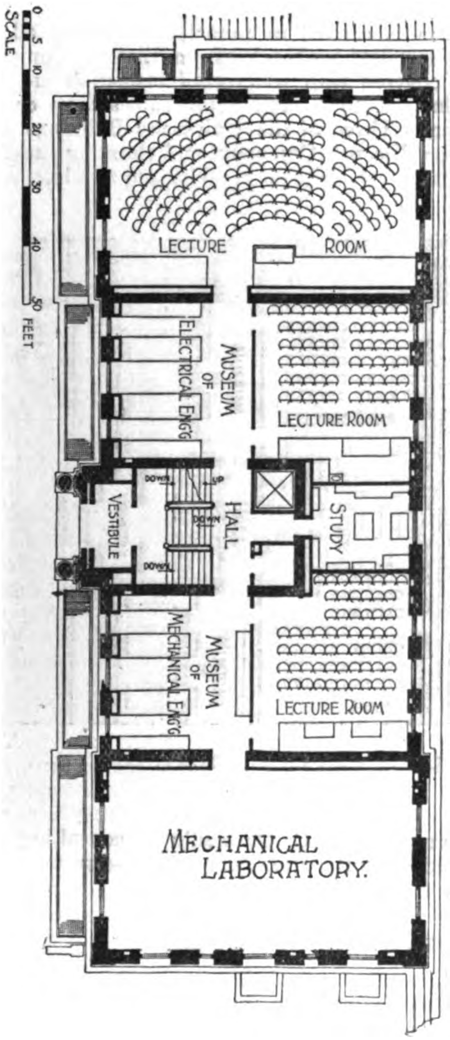
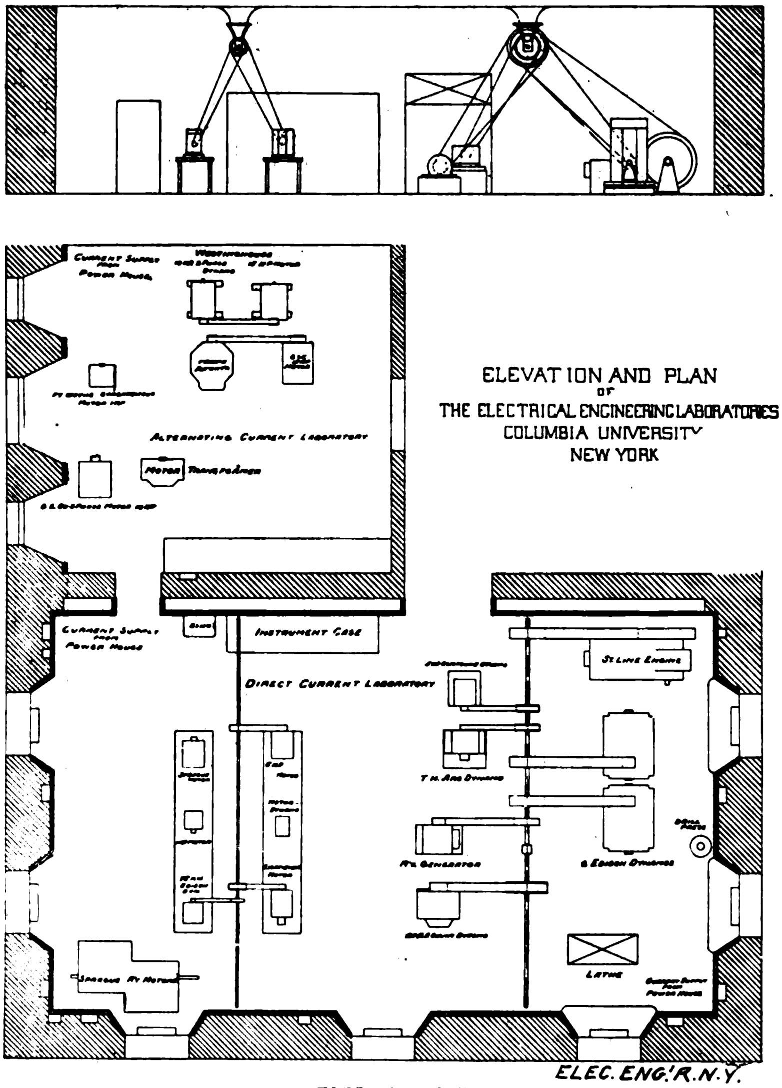


FIG. 3.



FIGS. 4 and 5.

MECHANICAL AND ELECTRICAL ENGINEERING LABORATORIES.—COLUMBIA UNIVERSITY.

also as a source of steady potential and current. The photometer room is equipped with all necessary apparatus for determining the candle power of arc and incandescent lamps as well as other sources of light. In the basement are situated the two machine laboratories, the larger containing the direct current machinery, while the smaller accommodates the alternating current apparatus. These are shown in cross section and plan in the accompanying illustrations, Fig. 3 and 4. In the former, a 50 h. p. high speed steam engine drives two lines of shafting, carrying pulleys controlled by friction clutches, to which the various machines are belted. The arrangement of the engine and shaft is such that two dynamos of 30 k. w. each can be connected to the engine, or either or both of the two machines may be used as motors to drive the line shaft, the current being obtained from the electric light and power plant of the University. In this way the breaking down of the motive power is rendered almost impossible and an excellent demonstration of the two methods of driving is made.

The various dynamos which are belted to the line shaft include examples of 115, 230 and 500 volt constant potential generators, constant current arc lighting dynamos, and other typical machines. Several types of stationary and railway motors, as well as motor-dynamos are also placed in this room. Machine and hand tools are provided in one corner of this laboratory for making and repairing apparatus, attachments, etc. Complete sets of ampere and volt meters, speed indicators, transmission and absorption dynamometers, etc., are available for testing the various dynamos and motors. The smaller machines are mounted upon two long heavy tables, as represented in the illustrations, which brings them to a convenient height and affords space for instruments, note books, etc.

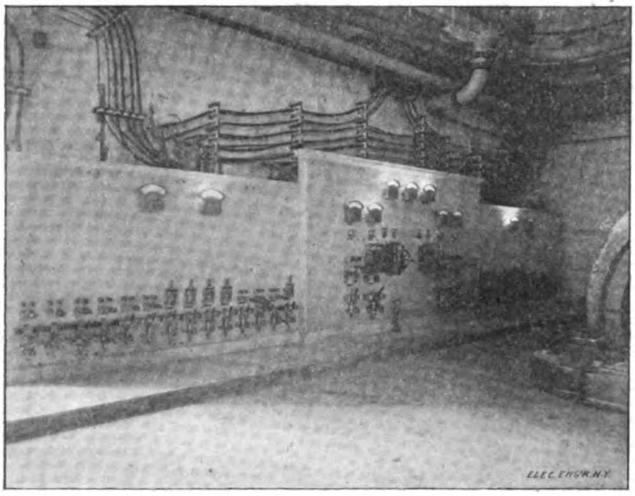
In the other machinery laboratory, the alternating current apparatus is placed, including single and polyphase generators, induction and synchronous motors, as well as various types and sizes of transformers. Each generator is driven by its own electric motor, enabling its speed to be independently regulated.

LECTURE ROOMS AND ELECTRICAL LABORATORIES.

On the first floor, a plan of which is shown in Fig. 5, are situated the smaller lecture room (seating 70), ordinarily used for class work, and the larger lecture room (seating 150) for combined classes. In the Chemical Building, immediately adjoining, a still arger lecture room (seating 350) is available for meetings and public lectures. All of these rooms are provided with an ample supply of electrical energy of different forms as well as gas, water, and other facilities to enable experimental demonstrations to be conveniently and effectively performed. For example, dyanmos, motors, and other apparatus of practical size are shown in actual operation to illustrate the lectures, this being made a special feature of the instruction.

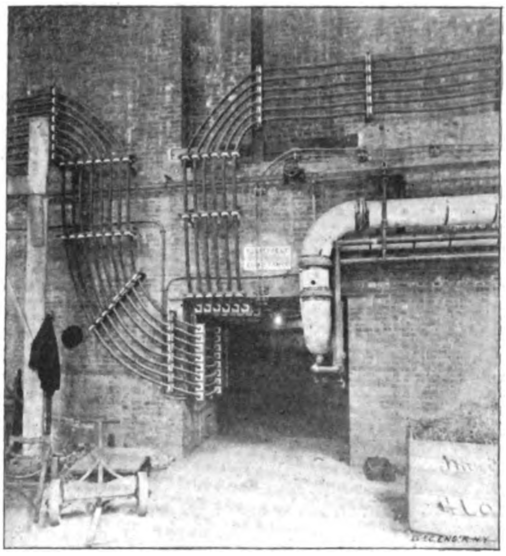
The museum contains cases for the collection of apparatus, models, materials, etc., relating to electrical engineering. This museum adjoins the lecture rooms so that its contents can be conveniently used for illustration.

On the third floor are located the large instrumental laboratory, the research room, and the studies of the officers. The



MAIN SWITCHBOARD, COLUMBIA UNIVERSITY POWER PLANT.

laboratory contains a number of tables on which the instruments are permanently set up ready for use. These include various forms of galvanometers, ampere balances, standard cells and resistances; apparatus for measuring inductance, magnetic permeability, hysteresis, and leakage; laboratory standard volt and amperemeters; telegraph, telephone, and electric signaling systems; thermo-electric and electrical heating devices; Röntgen ray apparatus. The research room is used for special post-



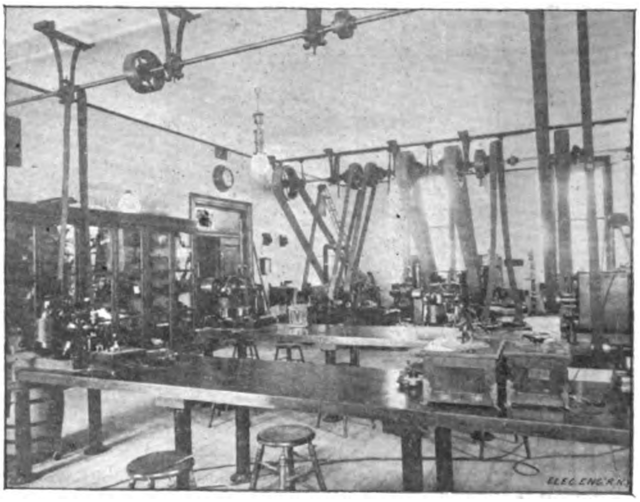
FEEDERS EMERGING FROM TUNNEL, COLUMBIA UNIVERSITY.

graduate and thesis work, and is fitted up according to the lines of investigation that are being followed.

THE POWER PLANT.

A most important facility is the large and reliable supply of electrical current which is afforded by the central power plant of the University. This consists of boilers having an aggregate capacity of 2,000 h. p., two low speed Allis-Corliss engines directly connected to two Crocker-Wheeler dynamos of 100 h. p. each, and two high speed engines directly connected to two Crocker-Wheeler dynamos of 100 h. p. each. Space has been reserved for a fifth machine of 400 k. w. capacity. Running along the east wall of the dynamo room is the switchboard, of white marble. The right hand panel controls the lighting, and the left hand, the power circuits. The centre panel has the generator switches mounted on it. The bus bars on the generator panel are divided into three sections with two bus junction switches so that light and power may be supplied independently of each other. The switchboard was built by the Incandescent Arc Light Company. This electrical generating plant, having a total capacity of 750 h. p., and illustrating the latest practice in electrical engineering, furnishes current for electric lighting and for driving the motors and fans used in ventilating all of the buildings. Special conductors are also laid to convey to all the laboratories as well as lecture rooms of the Electrical Engineering Department an ample supply of current for experimental work.

The feeder system is carried in tunnels connecting all the buildings and was installed by the Western Electric Company. The heavy cables covered with waterproof insulation are supported on porcelain insulators. The figure shows them emerging from the tunnel. Three of the University Buildings were wired by the Tucker Electric Company, and three by the New York Electric Equipment Company. The entire electric in-



VIEW OF ELECTRICAL LABORATORY, COLUMBIA UNIVERSITY.

stallation was planned by M. C. O. Mailloux, consulting electrical engineer, and its installation was carried out under the direct supervision of Mr. C. E. Knox.

THE PHYSICS DEPARTMENT.

The Physical Laboratories and lecture rooms occupy four floors of the Physics Building on the eastern side of the University grounds. The building is supplied with all ordinary conveniences, including electricity for power and light, compressed air, and steam. There is a vertical shaft 95 feet high with gas, electric, and water outlets at every ten feet. In the sub-basement a constant temperature room is placed 12 feet below the surface of the ground. A platform on the roof is available for meteorological observations, an instrument room being directly below. There are two lecture rooms, a library, an apparatus room, and laboratories of various kinds.

The general elementary laboratory includes in its equipment, linear and circular dividing engines of various designs. For measurements of mass there are provided balances with weights, specific gravity apparatus, hydrometers, aerometers, and the various forms of vapor density apparatus. Standard barometers, pendulums, and apparatus for studying elasticity, are provided; also apparatus for the study of sound.

Thermometers and apparatus for their calibration, and determination of zero and boiling points, are supplied; also apparatus for determination of coefficients of expansion, for latent and specific heats and calorimetry.

The optical rooms are furnished with spectrometers of different designs, spectroscopes, telescopes, microscopes, sets of lenses,

prisms and gratings, optical benches, photometers, and apparatus for calorimetry, polarized light, spectroscopy.

In the rooms devoted to electricity are galvanometers of various patterns, high and low resistance, ballistic and damped; electrometers, magnetometers, standard cells, resistances, rheostats, and bridges of all types; condensers, batteries, keys, arc and incandescent lamps, amperemeters and voltmeters.

THE MECHANICAL ENGINEERING DEPARTMENT.

The Mechanical Engineering Department is located in the Engineering Building and in the Annex, the space and equipment provided for it being greatly increased at the new site. This improvement is made not only on account of the importance of this branch in the Electrical, Civil, and Mining Engineering courses, but also because regular courses in Mechanical Engineering have now been opened at Columbia for the first time, the space at the old site not having been adequate for the purpose. The department has the following equipment:

The Wood-working and Machine Shops are located in the Teachers College, 120th street. For wood-working there are carpenter's benches with their kits of tools, speed-lathes, saw-benches and planers. For forge and blacksmith work there are forges with anvils and tools, a Bradley hammer and a Billings & Spencer drop-press. For metal-working there are engine-lathes with swing from twelve inches to twenty inches, planers, shapers, drill-presses, a universal milling machine, universal grinding machines and a Jones & Lamson turret-lathe.

The Testing Laboratory is equipped with high grade testing machines for tensile, transverse, torsion, and compression tests. Their designs are of diverse types to give wide experience in handling, and they are fitted with the best and newest appliances for observing and recording deformations of test-pieces. The Emery testing machine of 150,000 pounds capacity is used as a standard of reference.

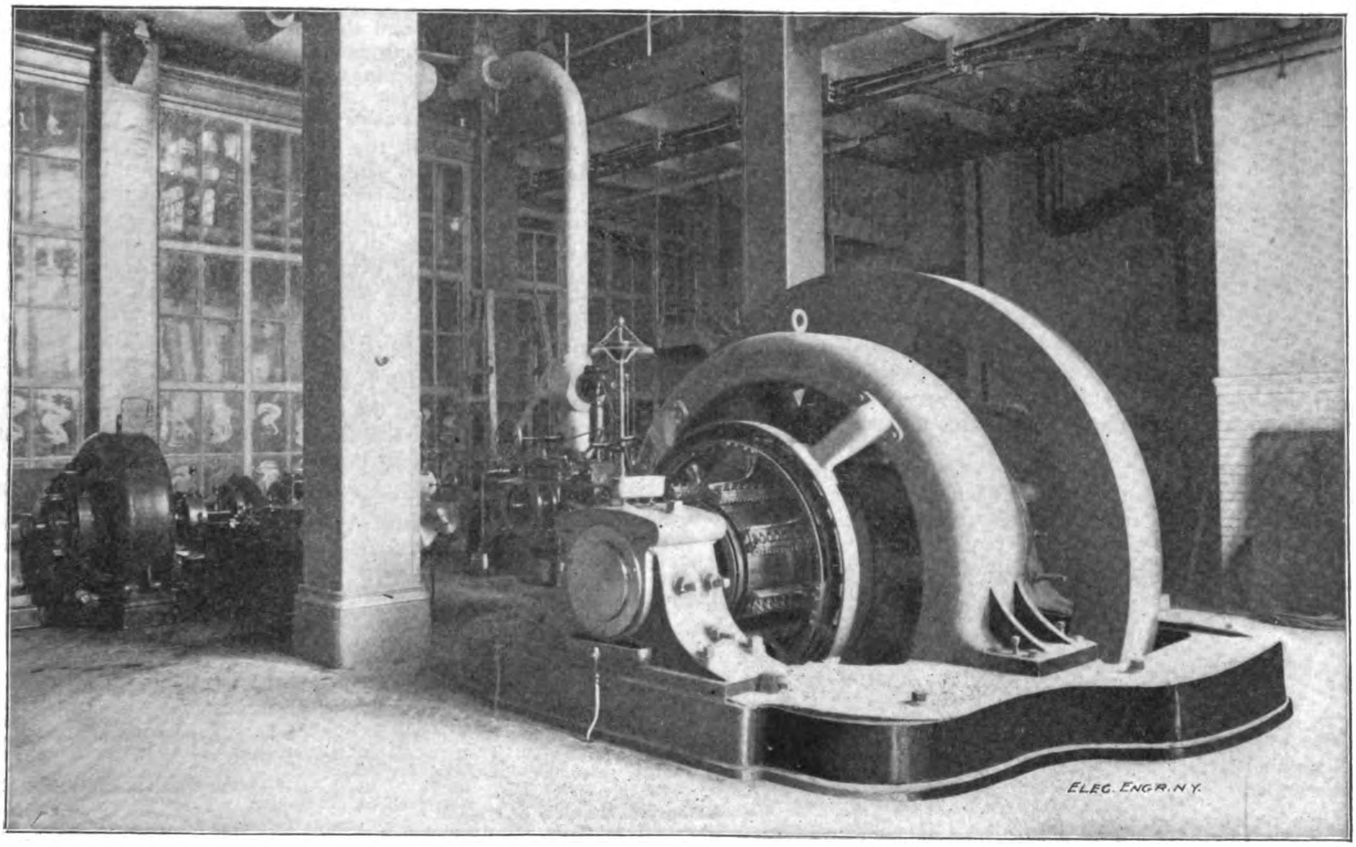
The Mechanical Engineering Laboratory is well supplied with dynamometers of transmission and absorption types, with oil testing appliances, speed recorders, tachometers, weighing and measuring apparatus, anemometers, gauge testers, and the like, and representative machines and mechanisms for calibration and tests of efficiency.

The Steam Engineering and Motive Power Laboratory has an extensive series of indicators, with appliances for calibrating and standardizing them, test gauges, thermometers, calorimeters, pyrometers, and apparatus for boiler and engine tests. A triple expansion steam engine of the Reynolds-Allis-Corliss design is arranged to work as an experimental steam engine by making it a three-stage air compressor, and having all facilities for the accurate measurement of efficiencies. A full line of boiler feed injectors is mounted for display and experiment. Steam engines of various other types, steam pumps, a 10 h. p. De Laval steam turbine, hot air and gas engines are at hand, and surface condensing appliances as well. The department has also a cross compound two-stage air compressor, the cross compound steam end of which with reheater, combined with the cross compound air end with intercooler, makes a most complete example of applications of thermo-dynamic theory to practice. This laboratory is known as the Allis Laboratory, and was founded in memory of the late Edward P. Allis.

The Hydraulic Laboratory contains tanks, weir-notch equipment, gauges, current meters, water meters, and motors for test and experiment. Constant pressure is secured by air pressure upon the water in a closed tank, thus doing away with a standpipe. For heavier pressures, above 100 pounds per square inch, an adjustable accumulator is used. Pumps of large capacity give the necessary quantity of water for orifice tests and drills in hydraulic engineering. The equipment of this laboratory was presented as a gift to the University as a memorial of the late Henry R. Worthington, of New York City.

The Drawing Academies are particularly well lighted and of large extent, and are fitted with the best forms of drawing tables and furniture, as well as extensive collections of patterns, models and illustrative drawings, blue prints, photographs, and prints, which are useful as copies, and for training in design. Sectional models of actual machines and structural material are abundant, and for the study of projection, stone cutting, and warped surfaces, there is a set of the Ollivier models, in which the elements of surfaces are represented by tense threads. In connection with the Drawing Academy is a room for blue printing and other solar work, and a photographic dark room.

The Cabinets or Museum Collections of Mechanical Engineering exhibit models of mechanical movements, mechanisms, and gearing, also material which has failed in service and under test.



DYNAMO ROOM, COLUMBIA UNIVERSITY, NEW YORK, POWER PLANT.

Specimens of apparatus and materials for practice are also included.

The Chemical Department occupies Havemeyer Hall, which is located at the northwestern corner of the group of buildings. It contains several chemical lecture rooms, fully supplied with apparatus and instruments and all modern facilities for the experimental illustration of the different lecture courses. The museum of general inorganic and organic chemistry, and of the chemical arts, contains the elements and all their more important compounds; representative sets of specimens of all classes of compounds, materials, and products, together with models, pictures, and diagrams. The qualitative laboratory is provided with tables, reagents, and all the necessary facilities to enable each student to become familiar with the reactions of the different metals and salts. The student is required to repeat all the experiments of the course of instruction at his own table in this laboratory. The quantitative laboratory is provided with tables, reagents and all the necessary apparatus and instruments to enable the student to actually execute quantitative analyses. There is also a laboratory specially fitted up for electro-chemical work.

The theoretical as well as practical branches of Electrical Engineering are taught by Professors F. B. Crocker and M. I. Pupin, and Messrs. G. F. Sever, W. H. Freedman and S. G. F. Townsend.

Municipal Electric Lighting.[1]—IV.

BY PROF. JOHN R. COMMONS.

FEWER "OUTAGES" UNDER MUNICIPAL OWNERSHIP.

IN the matter of "outages," too, the records for private plants are usually quite imperfect. Deductions are made from the contract price before payment is made by the city; but here is room for the political influence of the companies. The policemen are usually required to report outages, and in Syracuse the convenient practice obtains of reporting to the electrical company, which then reports to the city on their own outages.

For the City of Detroit the following comparison is made by the Public Lighting Commission of the outages under private and under municipal operation.

TABLE IV.

CONTRACTOR OPERATING 1,279 LAMPS, 1893-4.

Month.	No. lamps out.	Hours out.	% Lamps out.	% Hours out.
October	1,319	6,825	3.326	1.500
November	1,372	11,988	3.575	2.455
December	2,710	20,485	6.835	3.867
January	787	4,304	1.985	0.834
February	2,898	17,642	8.092	4.131
March	1,177	5,317	2.943	1.270
April	1,729	8,930	4.506	2.551
May	1,273	4,833	3.211	1.543
June	1,679	6,102	4.375	2.186

CITY PLANT OPERATING 1,483 LAMPS, 1895-6.

Month.	No. lamps out.	Hours out.	% Lamps out.	% Hours out.
October	152	1,040	0.335	0.201
November	95	774	0.266	0.137
December	138	940	0.300	0.154
January	47	372	0.116	0.062
February	42	301	0.098	0.059
March	28	235	0.061	0.048
April	84	350	0.179	0.088
May	63	283	0.138	0.080
June	25	137	0.056	0.042

It is also true that a steady improvement has been shown for the second year of municipal ownership, 1896-7, both in absolute amounts and relatively as well. A comparison of individual months shows the same superiority of public over private ownership. Not only does the city of Detroit get a steadier light but the brilliancy of the same is greater than that obtained from private corporations. The amount of the current used is maintained at 9.6 amperes, and the lamps burn at their full rated candle power.

Such facts as these not only may give us confidence that municipal enterprise does better work than private companies in the field of electric lighting, but they also lead us to look with suspicion upon any statistics favoring private operation which are based upon candle power cost, even if conscientiously compiled.

FAVORABLE COMMENTS OF OPPONENTS.

Turning now to the investigation of Mr. Foster we are at once impressed with its marks of candor and ability. Writing, as he does, under conditions opposed to public ownership, it is a matter of moment that he should publish such statements as these:

"The tone of all communications from those favoring the municipal side seems to have taken it for granted that the results shown would tell that side sufficiently well, and it must be admitted that in quite a number of cases such is the fact." Commenting upon the fact that the average cost per lamp of 2,000 candle power for installing a municipal plant complete is shown to be $249.30, and that this is very close to the price quoted by manufacturing companies to private purchasers, he remarks; "This is seeemingly contrary to the commonly made statement, that municipal plants are not bought as cheaply as private, said to be due in a measure to 'jobs.' Perhaps these 'jobs' may be offset in the purchase of private plants by the commission sometimes paid some member of the company." Again, he says: "In all fairness it may be said that the much-vaunted better management in private hands does not exist. In fact, the men in charge of city plants compare quite favorably with those in charge of private plants of similar size." These statements seem to show that in his own mind, whatever conclusions others may draw from his figures, his careful investigation has not proven what its projectors intended, viz., a demonstration of the greater economy of private electrical lighting; and his figures themselves, as will be shown below, when rightly examined in the light of the facts and of statistical rules, are not only not a disproof of the claims of municipal ownership but a strong testimony in their favor.

THE UNITED STATES AND FOREIGN COUNTRIES CONTRASTED.

Mr. Foster agrees with what I have already stated above with reference to operating costs, i. e., that there is comparatively little disagreement among the returns made by different investigators. In order to show this, he gives the following table from which fixed charges have been excluded.

TABLE V.

COMPARISON OF OPERATING EXPENSES PER K. W.

	Labor per k. w.	Fuel per k. w.	Supplies and offices per k. w.	Total cost per k. w.
14 American municipal stations, street lamps only.	$ .025	$1.0173	$ .0161	$ .0585
5 American municipal stations, incandescent.	.0244	.0226	.0126	.0596
1 American municipal station arc, new..	.0317	.0199	.0069	.0585
6 American private stations, mixed output of 5,300,000 k. w.	.....	.0095	.....	.0473
5 German stations, output 1,807,900 k. w.	.0218	.....	.....	.0469
23 English stations, average, Crompton..	.0144	.0222	.0194	.0560
Ideal English stations, Crompton	.0040	.0054	.0170	.0264
Lowest items in 23 stations, Weaver....	.0074	.0126	.0173	.0373

Mr. Foster says in commenting upon these figures: "Attention must be called to the remarkable agreement of cost in the American municipal stations, and the average of the English stations, and again to that of the six large American stations and the German average; both of the last two are equipped with large units in engines and dynamos, which probably accounts for the cost being lower than in the others." He says also, "The item of labor is the one division of operating expense in which it is claimed the greatest expenditure will be made in municipal plants. If the average here shown may be considered accurate within reason, this belief is largely a myth, for (with the exception of Chicago where labor is 53 per cent. of the operating expenses) the percentage for labor is less than usual in private plants. Either very low wages and very poor help are the rule, or the item has been classed wrongly."

It is when we come to the matter of "fixed charges," including interest, depreciation, insurance and taxes, that we find the widest divergences between the advocates and opponents of municipal ownership. It is here that almost the entire difference

[1] Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec Engr.

between the figures of Foster and Parsons is to be found. Mr. Foster estimates interest uniformly upon the entire cost of the plant up to date at the uniform rate of 6 per cent., unless the officials have given him a different rate. As the actual rate is thus given in only sixteen of the thirty-four cities whose returns he has tabulated he has guessed at the rate of eighteen. In every case where I have been able to find the actual rate as against his guess, the rate is 4 per cent. And it may be stated as a general rule that the smaller cities in the East can borrow money without difficulty at 4 per cent., getting a premium on the bonds at this rate, and in the middle West no higher rate than 5 per cent. is paid, rising to six and seven on the Pacific coast. Chicago borrows money at 3 per cent., whereas Mr. Foster's gross interest charge for that city figures out 4.2 per cent. A difference of 2 per cent. on the average investment of $250 per arc light makes a difference of $5 per year per arc in the aggregate cost.

INTEREST COMPUTED ON OUTSTANDING DEBT ONLY.

Prof. Parsons estimates interest not on the total cost of the plant as does Foster, but upon the actual amount of bonds outstanding. Therefore if no debt has been incurred for the electrical plant, or if the debt has been paid, interest entirely disappears from his calculation of cost. In cities without a debt on the plant, therefore, the difference between the total costs of Foster and Parsons would average $15.00 per arc lamp per year.

Parsons' reason for including interest not on the entire cost of the plant, but only on the outstanding debt, is that in municipal ownership the people pay interest to themselves, except where a debt makes a creditor in effect part owner, and therefore, to calculate interest on the total cost in excess of the debt would be only to take out of one pocket and put into another. This reason does not appear sound. Taxpayers and consumers are not the same individuals, except in street plants alone. The true economic principle seems to be as follows:

The taxpayers must pay for street lighting either to a private company or to a municipal plant. If the cost of the lamps operated by the latter, including interest, taxes, and insurance, is less than the amount that would be paid to a company, the difference is a saving to taxpayers which would not occur except with municipal ownership. If, therefore, new construction and payments on the principal of the debt as far as met out of taxes, do not exceed the amount of this saving, such disposition of the taxpayers' money is not an assessment upon them, or an investment made by them upon which interest should be received, because they have no alternative investment and could not have gained interest upon it anyhow, but it is an administrative economy tending to the ultimate extinction of the debt and further lessening of taxes. The city of Detroit paid $175,000 yearly for 1,279 private lights, and now gets 1,716 arc equivalents for $144,000 including interest and lost taxes. The difference of $30,000 yearly, if put into new construction or a sinking fund, is not an increased burden upon the taxpayers, and therefore does not give them a right to charge interest upon it to the consumers.

Municipal Ownership in Glasgow.

Municipal ownership is one of those phrases which, in a certain order of mind, take the place of reasoning, investigation, common sense. It is invested with a magic, a miracle-working, power which makes anything claimed for it credible. The city gas works in Philadelphia were long the substitute for argument in the mouths of advocates of municipal ownership. But their recent abandonment, after confessed losses and scandals, has led the champions of municipal operation of the public lighting and transit services to look more and more abroad for comfort, and Glasgow is the city whence they have derived most of it. So wild have been the romances set afloat about the immense profits derived by Glasgow from its control of public franchises, that the Lord Provost has been compelled to issue the following circular letter:

"The Lord Provost of Glasgow has received communications from all parts of America desiring confirmation of a statement to the effect that the citizens of Glasgow would be free from all taxes or rates in consequence of the profits derivable from their gas, water, electric lighting, and other undertakings of the government. I have accordingly been requested by the Lord Provost to inform you that this statement has no foundation in fact. There is no probability of this city being exempt from taxation.

"JOHN S. SAMUEL, City Chambers."

Thus is the socialistic millennium adjourned again. Taxes are not yet abolished, even by municipal ownership. Yet there is little doubt that if municipal ownership were given free course, it would ultimately make an end of taxes, for it would make an end of property to be taxed.—N. Y. Evening Post.

POWER TRANSMISSION

Electrical Installation in a Wilkesbarre Mine.

IN the mines of the Lehigh Valley Coal Company, four miles north of Wilkesbarre, Pa., an interesting electrical installation has been in operation during the past year. The main workings of the mines are under the Susquehanna River Flats eastward from the shaft toward that river from the Wyoming Hills—the Western outcrop of the anthracite coal belt. As the workings were greatly extended, the problem of handling the constantly increasing volume of water became daily more difficult and the haulage of coal by mules more expensive. A steam plant on the flats was impracticable on account of their

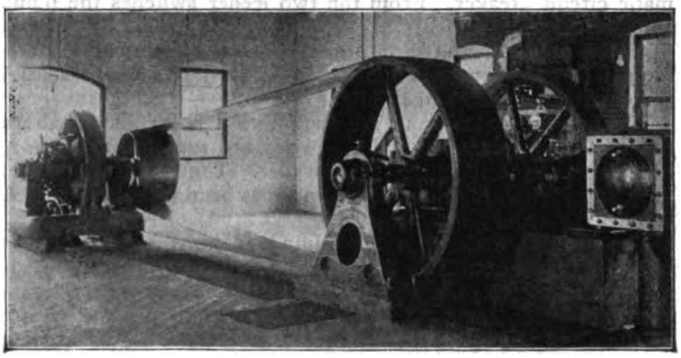


FIG. 1.—INTERIOR OF POWER HOUSE.

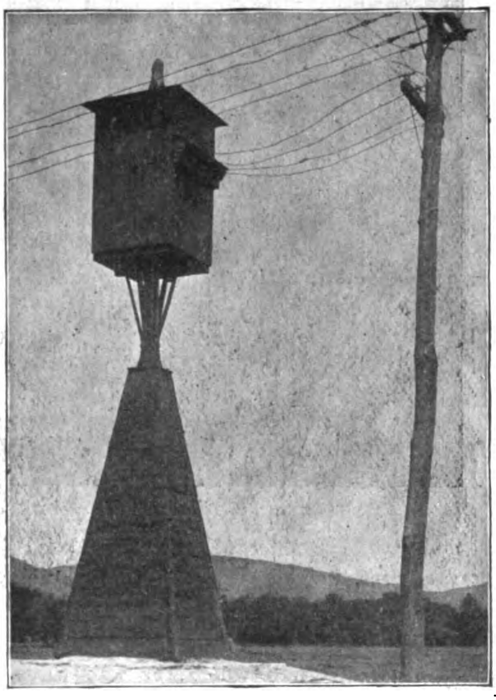


FIG. 2.—POINT OF SUSPENSION OF FEEDERS.

submersion and after careful investigation, the company decided to use electricity for the operation of the mine pump, and an electric cable hoist for the haulage of the coal over an extension of the main gangway.

The power house is placed near the head of the main hoisting shaft and contains the main hoisting engines, the generator and its driving engine. Steam is supplied from a battery of boilers set in another house about 200 feet away. The dynamo shown in Fig. 1 is a General Electric slow speed, 150-kilowatt direct current six-pole machine, driven by a Ball automatic tandem compound non-condensing engine. The speed of the engine is 200 revolutions per minute, that of the generator 400 revolutions per minute. The generator is compound wound for 500 volts at no load and 550 volts at full load. An oak switchboard is placed against the wall of the engine room and current passes from the generator to the switchboard through heavily insulated copper cables suspended on porcelain insulators in a conduit under the floor. The conduit is provided with a removable cover allowing ready access to the cables. The board is provided with two double pole feeder switches for the pump and hoist circuits in addition to the main double-pole station switch. The pump circuit is protected by fuses, the hoist circuit by an automatic circuit breaker. From the two feeder switches the pump and hoist circuits are carried to the pole line. The positive and negative sides of each circuit are connected to suitable lightning arresters to protect the instruments and generators from the destructive effects of lightning.

The pole line runs from the station to a point almost above the center of operations and the wires are run through a bore hole especially drilled for that purpose. The poles are 30 feet long and each carries one four pin cross arm with iron braces, wooden pins and glass insulators.

The positive feeders for the pump and hoist circuits consist of two separate 0000 B & S wires, and two 0000 B & S provide a common return. At about 5,000 feet from the power house two bore holes, each 350 feet deep are driven from the surface of the flats. One is provided with a six-inch iron pipe as a casing for the wires, the other with a 12-inch casing for the pump discharge. The six-inch pipe rises about 18 feet above the surface of the ground. The opening is thus protected against any great rise of water during freshets. A small cable house is supported on this pipe into which the line wires pass and make connection with the cable in the bore hole. The two positive feeders are connected to two separate cables, the two common return wires to one large negative cable. Each cable is heavily insulated with rubber and jute braid and then leaded and armored with iron wire protected from corrosive and electrolytic action by tarred jute. The cables are supported from the top of the stand pipe. The method of suspension of the cables shown in Fig. 2 is unique. Six cast-iron plates 1¼ inches thick and 18 inches square, are drilled with three 2-inch holes close together near the center of the plate. The six plates are placed one above the other on top of the stand pipe and the cables pass through the holes in all of the plates. The six plates are divided into three sets, each two in a set forming a clamp tightened by several small bolts. As one cable passes through the bottom clamping set the iron armored wires are spread out and tightly clamped between the two plates. Another passes through the hole in the first set and is clamped between the plates of the second set, the third armored cable being held between the third set. Each cable is, therefore, supported by its own armor and a separate clamp. Three additional lightning arresters protect the cable and line wires in the cable tower.

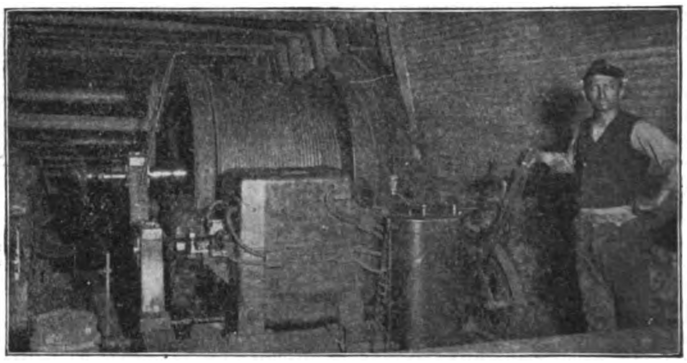


FIG. 4.—110 H. P. HOIST AT HEAD OF SLOPE.

At the bottom of the hole the cables are connected by single pole switches to the circuits operating the hoist and pump 600 feet distant. These underground wires are double rubber covered and are supported on glass insulators fastened to props along the ribs. A wooden switchboard carrying fuse boxes, main switch and starting rheostat for the pump is erected in the pump chamber.

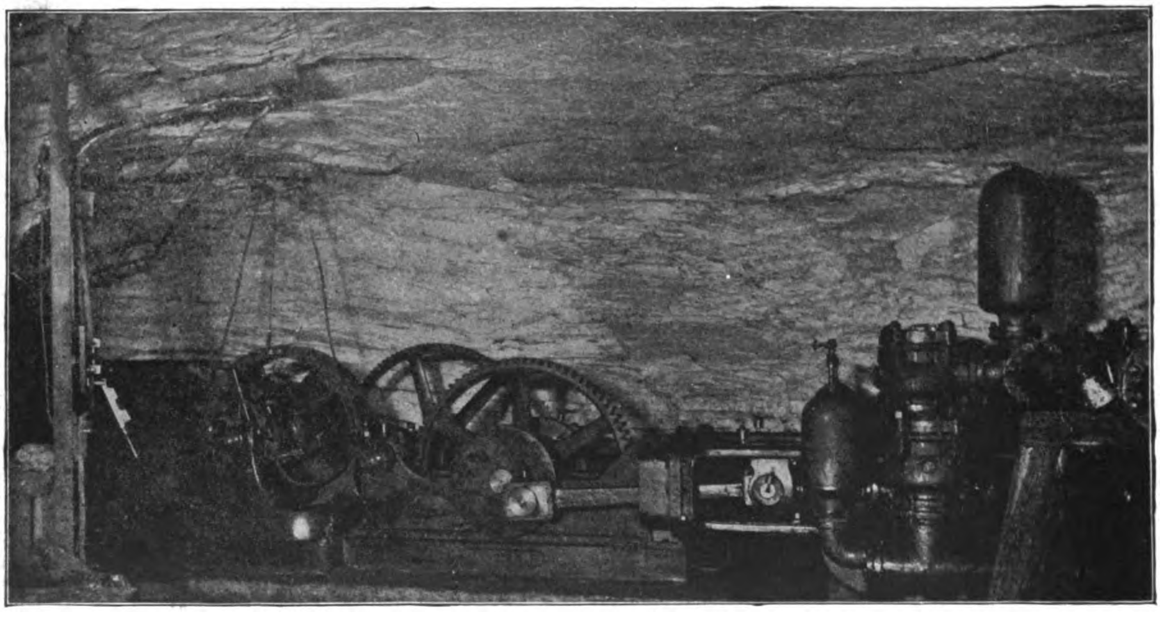


FIG. 3.—10 x 18 PUMP AND 85 H. P. MOTOR.

The motor for this pump, shown in Fig. 3, is mounted on a cast-iron bed plate and is geared by a double reduction gearing to the crank shaft operating the plungers. The motor is a General Electric shunt wound machine, with a capacity of 85 horse power continuously at a speed of 700 revolutions per minute. The pump is a duplex, double acting pot valve pump, manufactured by the Joansville Iron Works, with outside packed and connecting plungers, 10 inches in diameter by 18 inch stroke. The pump capacity at 25 revolutions is 600 gallons per minute, under a head of 360 feet. As with all pumps

operated with shunt wound motors the speed of the gearing is approximately constant—a great advantage where the pump receives little attention and where the pump capacity is limited. Should the pump happen to run on air, there would be no racing as in the case of air and steam pumps and the amount of energy consumed is only that required to overcome the mechanical friction of the rotating parts. The suction pipe drains from a large pump near the pump chamber and the water passes up through the 12-inch bore hole to the surface where a check valve prevents the water returning during any freshets when the pump is not in operation. A small 4 in. x 6 in. triplex plunger pump geared to a 5-horse-power multipolar slow-speed motor, pumps water up the small slope to the large electric pump.

The hoist shown in Fig. 4 is placed at the head of a small slope extending east from the parting at the foot of the main slope. The gangway in which the pump is placed is from 20 to 25 feet high and rather narrow. The hoist is placed on a platform built over the gangway and the operator stands on an auxiliary platform directly behind the hoist where he is not troubled by the vibration of the hoist when running. The motor is of the General Electric Railway type, completely closed to protect the windings from dust and moisture. It is series wound for 500 volts and is capable of developing 110 horse power for the intermittent work it is called upon to perform. The motor and drum are mounted on the same bed plate, and are connected by double reduction gears. The drum is of the friction cone clutch type, manufactured by the Lidgerwood Manufacturing Company, and is provided with two band brakes lined with wood. The clutch and brakes are operated by three levers and quadrants, while the motor is operated by a rheostatic controller to the left of the levers. The controller is provided with a magnetic blow-out. The hoist drum is 48 inches in diameter and 36 inches face and holds about 1,400 feet of one-inch wire rope. Under full load the rope strain on the hoist, at an average speed of 500 feet per minute is rated at 5,000 pounds. The hoist is operated under the single rope system, The empty trips are lowered by gravity and overhaul the rope, while the loaded trips are hauled up out of levels situated at intervals along the slope. The lowest level is about 1,200 feet from the hoist. The slope pitches on an average about 50 with a maximum of 80 at the approach to the knuckle, above which the empty and loaded trips pass on a parting directly under the hoist. The usual load up the slope is four loaded cars per trip at an average speed of 500 feet per minute. Each car weighs about three and a half tons, loaded, and in case of necessity the hoist is capable of hauling six cars per trip.

The installation of this plant was effected by the General Electric Company and since it was started it has operated continuously with satisfactory results.

NEWS AND NOTES

The Current Strength of a Lightning Flash.

To measure the current strength of a lightning flash seems almost impossible, yet it has been determined by noting the amount of permanent magnetism in certain rocks on the surface of the earth. The amount of magnetism in these rocks seemed out of proportion with the ordinary magnetism of the earth, so the proposition was advanced that it was caused by an electric current either passing through them or in the immediate neighborhood. Herr F. Pockels has recently made an investigation of sections of the basaltic rock of the Winterberg in Saxony, which show very irregular magnetism that must have been caused by a current of at least 2,900 amperes passing over the surface of the rock or else in the immediate neighborhood. Some basalt cut near a tree struck by lightning afforded him a better opportunity for estimating the strength of the current, which he has computed to be nearly 6,500 amperes.

MR. MARSDEN J. PERRY, of the Narragansett Electric Lighting Company, Providence, R. I., a well known banker, bought a rose souffle vase at the Dana ceramic sale for $5,000. He has one of the finest collections of porcelain in the country.

ELECTRIC TRANSPORTATION

Electricity on the Central London Underground.

IN our issue of June 30, 1897, we gave a general account of the Central London Underground Railway, the most important of all the undertakings of this nature in the world, with a map showing the route and the positions of the stations. Since that time extensions and alterations have been made, and we are in position to-day to present the following important data and illustrations which Mr. H. F. Parshall has furnished to "Engineering." The map accompanying this article shows the authorized lines of the Central London Railway, and indicates the routes of the city and South London and other electric and cable railways. The positions of the stations, and their distances apart, from centre to centre of the platform, are approximately as follows, starting from the western end of the line:

Shepherd's Bush to Holland Park, 1012 yards; Holland Park to Notting-hill Gate, 683 yards; Notting-hill Gate to Queen's-road, 768 yards; Queen's-road to Westbourne Park, 986 yards; Westbourne Park to Marble Arch, 1,288 yards; Marble Arch to Davies street, 642 yards; Davies street to Oxford-Circus, 699 yards; Oxford-Circus to Tottenham-court Road, 666 yards; Tottenham-court Road to British Museum, 682 yards; British Museum to Chancery-lane, 746 yards; Chancery-lane to Post Office, 1,163 yards; Post Office to Bank, 828 yards. This gives a total of 10,163 yards.

This railway is of especial interest to Americans as the entire

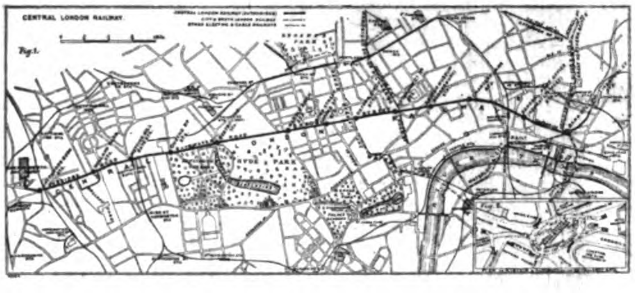


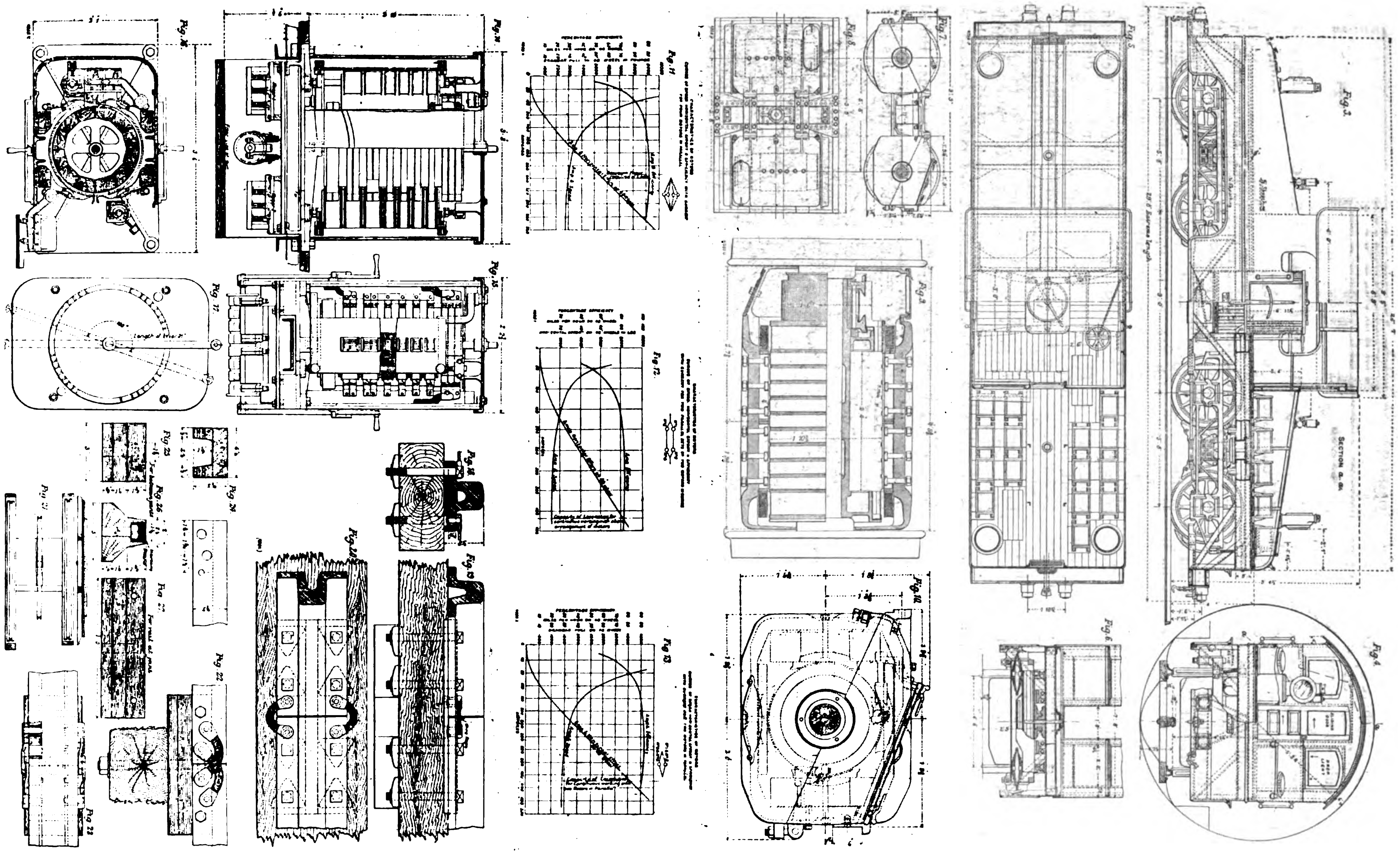
FIG. 1.—MAP SHOWING ROUTES OF THE CENTRAL LONDON AND OTHER RAILWAYS.

electrical equipment has been designed and manufactured in the United States. With the exception of the elevators, of the famous Sprague make, the entire electrical contract has been assumed by the British Thomson-Houston Company, Limited, representing in Great Britain the General Electric Company, of Schenectady.

The locomotives built by the General Electric Company are shown in Figs. 3 to 6, and the dimensions are given in the following table:

The wheel centres of the truck are	5 feet 8 inches and 6 feet
Distance from centre to centre of trucks	14 feet
Number of driving wheels	8
Total number of wheels	8
Diameter of wheels	3 feet 6 inches
Total wheel-base	20 feet 9 inches
Total length of locomotive	29 feet 8 inches
Total height	9 feet 8½ inches
Weight on each wheel	about 5½ tons
Total weight of locomotive	about 48 tons
Drawbar pull	14,000 pounds (6.2 tons)
Drawbar pull running at 22 miles per hour	8,000 lb (3.5 tons)

The weight of each locomotive will be about 45 tons. There will be four gearless motors on each, that is, one on each axle. The weight of the frame and coils of each motor, with field coils in place, will be 8,500 pounds, while the weight of the armature, complete with sleeve and conductor, will be 3,000 pounds, making a total weight for the motor of 11,500 pounds. The driver's cab is fixed in the centre of the locomotive (Fig. 3), giving him a capital look-out both ahead and astern. In the space over the trucks are fixed resistance coils (Figs. 5 and 6)



FIGS. 3 to 27 Incl.—DETAILS OF LOCOMOTIVE, MOTORS, CONTROLLERS AND TRACK CONSTRUCTION, CENTRAL LONDON RAILWAY.

with a passage way between them, the whole being inclosed by a sheet-iron cover.

The trucks and motors are illustrated in Figs. 7 to 10. The hollow axis of the armature is shipped directly on to the axle, and occupies the whole of the space between the wheels. The whole motor, which has an armature 1 foot 10½ inches in diameter and four field coils, is inclosed in an iron case, access to the interior of which is obtained through a door (Fig. 10). The efficiency of these motors is between 92 and 93 per cent. The temperature will not rise more than 90 degrees Fahrenheit on a two hours' run at full load. The performance of the motors with the 48-inch wheels originally proposed, is shown in Figs. 11, 12, and 13. The size of the wheels has since been reduced to 42 inches, and the power of the motor otherwise augmented considerably, in order that a high average speed may be attained.

Figs. 14 to 17 show the series parallel controller. At starting, the four motors are placed in parallel in pairs, and the two pairs in series. At the same time there is a resistance in series with each motor. Then one pair of motors is progressively short-circuited, and finally all four are placed in parallel. There are,

in all, twenty-two stages in the regulation. Each section of the line comprises two inclines of 1 in 33, joined by a length on the flat, so that the train is greatly accelerated by gravity at starting, and retarded as it approaches a station. It is only by the combination of these circumstances, and by the aid of the powerful motors, that the rapid services promised could be attained.

Figs. 21 to 27 show the third rail by which the current is conveyed to the locomotive. The return current passes through the ordinary rails (Figs. 18 to 20). The third rail is of steel weighing 80 pounds to the yard, and is a channel section. It is supported on creosoted wood insulators, and the joints are bonded with short flexible crown bonds. The track rails are of bridge section, weighing 100 pounds to the yard, and laid on horizontal sleepers. Each joint has two bonds.

It might be of interest to give a few figures of the estimated passenger capacity of the line. It is said that with 2½-minute trains, and all seats occupied, each person traveling the whole distance, about 85 million passengers could be carried in the year; but as everyone, naturally, would not go the whole distance, it has been estimated that 100 million persons would be carried in twelve months; or, rather, that that number of passenger journeys could be made in the time. That may appear a very optimistic view to take of the prospects of the railway. On most suburban lines there is a rush-in in the morning and a rush-out in the evening, at both of which periods seats are at a premium; in the third-class carriages they have sometimes to be shared by double the orthodox number of persons. For the rest of the day, however, traffic is apt to languish and one person to a compartment is not an unusual average, but in the streets on the central railway route there is traffic all day. Omnibuses and cabs are always going and the former if not always full are generally tenanted. The Central London Railway in virtue of its lifts and its continuous service of 2½ minutes will be in many respects as convenient as an omnibus and far more rapid. The stations are so close together that passengers can hardly be landed at a great distance from their destination supposing it to be on the line of route. Mr. Forbes, of the London, Chatham and Dover lines, estimated that there would be $8,000 per mile per week for the local traffic on the Midland Railway. In 1866, Mr. Baker (now Sir Benjamin) gave $4,030 to $5,395 per mile per week as the percentage on the Metropolitan Railway between Paddington and Farringdon street. Between 1867 and 1890, however, the London population has increased 35 per cent., but the number of passengers in public conveyances has grown in much greater proportion, that is from 64,000,000 to 459,000,000. That is to say the ratio of travel has increased twenty times as fast as the growth of population, taking the number of journeys only, irrespective of their length.

The engineers to the Central London Railway are Sir John Fowler, Sir Benjamin Baker, and Mr. Basil Mott (who succeeded Mr. Greathead); Mr. Henry Tennant, late general manager of the North-Eastern Railway, is chairman, and Mr. R. O. Graham, also an old North-Eastern Railwayman, is the secretary. The Electric Traction Company, of which Sir R. Farrant is chairman, has undertaken to construct and equip the line for a lump sum of a little over 15 million dollars, and contracts for the construction have been let to Messrs. Walter Scott & Company, Messrs. John Price & Company, and Mr. John Talbot.

Electricity on Board the "Niagara".

THE Niagara, lately launched at Wilmington, Del., and belonging to Howard Gould, is the largest steam yacht ever built in the United States, and in point of tonnage is only equalled by three or four yachts in the world. Her displacement is about 1,900 tons. She is 272 feet long, 36 feet beam, depth to spar deck 27 feet, draught 16 feet. She is bark rigged, has three decks, a double bottom and twin screws. The yacht, which was built by the Harlan & Hollingsworth Company, is luxuriantly furnished and all comforts are amply provided for. The electric plant of the Niagara will be as complete as has ever been installed on board a ship. It will consist of two dynamos, each capable of furnishing 400 sixteen-candle power lamps, and a storage battery with a capacity of eighty lamps. When desired the dynamos can be made to operate 900 display lights at night, also a powerful searchlight on the bridge. Electricity will be employed in every conceivable way on board the Niagara. There will be electric heaters, curling tongs, smoothing irons, ranges, warming pans and lifts. Electricity will operate the laundry and drying rooms; it will heat chafing dishes and bring out the music of the big orchestrion. The ship will be electrically and steam heated throughout with radiators, coils and pipes in the usual manner.

Sprague Multiple Unit Control and the Adoption of Electricity on the Brooklyn Elevated System.

THE recent news of the adoption of electricity on the system of the Brooklyn Elevated Railroad Company came very much in the nature of a surprise to the public. Attention had been so intently fixed on the Manhattan Elevated, and rumor was so rife with what its managers proposed or did not propose to do, that most people lost sight of the problem and conditions confronting a like road across the Bridge, but also within the borders of Greater New York. Hence, the statement that the Brooklyn concern had done business while the New York road had merely been talking against time, was a startling event, and even now there is much conjecture as to how it all happened. We are glad to be able to give herewith what we understand to be the correct data as to the incidents leading up to the adoption of electricity, at a time when the determination in its favor means very much. It will be seen that credit is due Mr. Frank J. Sprague and the gentlemen associated with him, for this momentous decision.

For about three months, pending the hue and cry on the Manhattan, and realizing that the competitive conditions on the Brooklyn Bridge would require some initial electrical equipment on the Brooklyn road, Mr. Sprague and his friends had been quietly doing effective work. As long ago as May, Mr. George Cornell, chief engineer of the road, stated in a communication to one of the manufacturing companies that he must be able to run individual cars, but despite this fact, it is stated, the companies, other than the Sprague Company, proposed locomotive systems, some with visionary schedules, and another actual schedule determined by test at Schenectady, all requiring the locomotive application, with the suggestion on the part of Mr. Martin, the electrical engineer of the Bridge, of using two locomotives in a train.

Mr. Cornell meanwhile went to Schenectady, and saw the initial trials of the Sprague multiple unit control in August, and publicly stated that that was the only system which would be accepted on the road.

Later, Mr. John Lundie, of Chicago, who made the report for the Illinois Central, was requested to come to New York by Mr. Sprague to make a very thorough investigation of the Brooklyn Elevated Railroad and its problems in all its details. He was put in close touch with Mr. Cornell, and a most elaborate series of investigations was made extending over a number of weeks involving all of the questions of cost of equipment and operation under various schedules and varying accelerations. The results when presented to Mr. Cornell and indorsed by propositions by the Sprague Company, presented through Mr. Shepard and Mr. Sprague, were of such a convincing character that Mr. Cornell absolutely decided on the use of the multiple unit control and specifications were issued calling separately for motors and controls. These were the papers which were stolen from Mr. Sprague's desk recently, and for which a reward of $1,000 is offered.

The Walker Company was the lowest bidder, and received the order for the motors. The Sprague Company bid on the controls, and the motors have to be built to meet their requirements. The whole question of the equipment and the important fact is the abolition of the locomotive and the adoption of the individualized cars with the Sprague multiple unit control.

There has been, it is now stated, no general contract for the road signed, but simply an order placed for 48 motors mounted on trucks, and from there on the equipment is absolutely a Sprague equipment, put in under Sprague advice and under Sprague responsibility to meet the requirements determined upon.

The cars are arranged so that they can be run on a 16½ or 18-mile schedule, depending upon whether two or four motors are used. The very remarkable fact was brought out by Mr. Lundie, considering a given car mileage where high schedules are required, that whatever the schedule required, the total cost of an equipment, including the central station, transmission, storage battery equalizers, trucks, motors and controls, as well as cost of operation, was entirely in favor of the multiple unit

system. In fact, as Mr. Lundie stated, "every reason, commercial, practical and economical, was in favor of the multiple unit system."

Of course, such schedule speeds as are possible with this system, limiting the weights of cars without loads to perhaps 21 to 23 tons, are absolutely impossible to a locomotive system because with the two motor equipment, from 59 to 63 per cent. of the weight of the train is on the drivers, and with the four motor equipment, the entire weight of the train.

With regard to the future of the Brooklyn Elevated, it is probable that the Fifth avenue will be the first one equipped and the multiple unit system will be used, but the make of motor is not yet determined. With the individualized system, high schedule speeds are possible on existing structures; that is, the highest schedule that it is possible to maintain with existing station intervals and grades.

The statement made in various papers some time ago that double an 18-mile schedule could be maintained on an underground railroad, is "simply rot," Mr. Sprague says. Eighteen to nineteen miles is the maximum possible using every wheel in a train where the station stops are only a third of a mile apart. Higher speeds are only possible where the stops are at less frequent intervals, no matter whether overhead or underground.

Asked his views as to the Manhattan situation, Mr. Sprague says, very frankly: "With regard to the Manhattan road, we have had recently no conference whatever with the Manhattan people. They have not so far as I am aware, made any practical investigation of the multiple unit system. All proposals which have been made to them by other companies have been on the locomotive idea, and so far as I can judge, have been attended by a good many misstatements of fact. I hope, as every other engineer should hope, that when the Manhattan people have come to final conclusions in their negotiations with the Rapid Transit Commission about extensions, that they will then invite a comprehensive bid covering every detail of equipment, and if that is done we shall be perfectly prepared to submit such plans to them as cannot but command serious attention.

"I am perfectly certain that the multiple unit system if anything is of more vital importance on the Manhattan road than anything else, not only because of its size and extent, but because of the limitations of strains on the structure, and the tremendous competition that the Metropolitan and Third Avenue roads will afford when projected equipments are put in operation will demand the highest possible schedule speed on the elevated railroad. There is only one way to get it, and that is to make use of the weight of the train on the drivers.

"Other important roads are going to adopt this system, but of these I cannot speak at present. We do not control all methods of operating cars electrically. That is a foolish statement, by whomsoever made, but we do control, and have reduced to practice the only effective method of handling a number of individually equipped cars by what is called the multiple control system."

Caution, Liquidation and Firmness.

With the possibility of war with Spain hanging over their heads, it would indeed be strange if American investors did not husband their resources and speculators take in sail. This country does not want to fight, but if it has to, it will, and it will vote and raise ten times $50,000,000 for the purpose. In the meantime it is hoping and praying for honorable peace, and working just as hard as though no war scare was in the air. There is continued briskness in trade, and almost every line reports an excellent demand. Orders are very large for wheat, flour, pig iron and copper. The advance in copper appears to be thoroughly justified.

During the week, 29,538 shares of Western Union were sold between 85 and 84¼. Of General Electric there were 13,223 shares sold, from 31 down to 30. In Boston, 869 shares of American Bell Telephone exchanged hands at from 262 down to 249½. In Canada, Commercial Cable dropped 8 points to 177, and the price is now 11½ points below the highest of this year. New York Edison is steady at 130.

Copper is 11.87½ cents, and it is safe to say no lower price is looked for. Heavy steel rail, Eastern mill, is a trifle weaker, at $17.50. A copper sale to home consumers of 4,000,000 pounds is rumored.

Amateur Model-Making Competition at the Electrical Exhibition.

A committee consisting of Prof. Morris Loeb, Dr. C. A. Doremus, Dr. W. E. Geyer and Mr. T. C. Martin has drawn up rules and regulations for an amateur model making competition in connection with the Electrical Exhibition. Printed forms can be had from the management, 15 Cortlandt street. The classes are given below, each class having prizes not to exceed $50.00 and bronze medals, the exhibits to be judged by a committee of five well-known men. It is believed that the contest will awaken general interest and elicit some beautiful and interesting apparatus. There are a great many young people and students in and around New York who find pleasure in handiwork of this character. The classes are as follows, and the exhibits must be entered a week before the exhibition begins:

CLASS A.—Working model or actual machine of a dynamo-electric or electro-dynamic type: made by one or more boys under 21, so far as designing, lathe work, assembling and finishing is concerned.

CLASS B.—Instrument of precision, made by amateur or student; including galvanometers, resistance bridges, etc., etc.

CLASS C.—Practical application of electricity to communication, the assembling and finishing to have been the work of a single exhibitor.

CLASS D.—Ingenious application of electrical appliances to domestic, etc., uses by an amateur under 18; none of the apparatus to be necessarily of home manufacture.

CLASS E.—Design or working drawing of an electrical appliance, or installation, made within the past twelve months by a student of a recognized chartered institution, and bearing the instructor's certificate as to its bona fides.

CLASS F.—Design or instrument made by a teacher, below the grade of College Professor, for illustrating some electrical law.

Commercial Cable Co.,

The annual meeting of the Commercial Cable Company was held last week. The revenue from the operations of the cables, after deducting all expenses, amounted to $1,200,155, an increase of $76,502 over the previous year. The net revenue from the land lines, Postal Telegraph, was $645,185. The net revenue from the combined systems was $1,845,340.

Out of this have been met the interest on the first mortgage bonds and debenture stock, dividends of 7 per cent. on the stock, and bonus of 1 per cent. on the capital stock—a total of $1,440,000—leaving the balance of net revenue for the year $405,341.12. The further sum of $250,000 will be set aside and invested in high-class securities, as an addition to the reserve fund, which will then stand at $2,608,329. There have been added to the land line system during the year 933 miles of new pole line and 3,966 miles of wire.

The directors elected for the ensuing year were John W. Mackay, James Gordon Bennett, Gardiner G. Howland, Col.

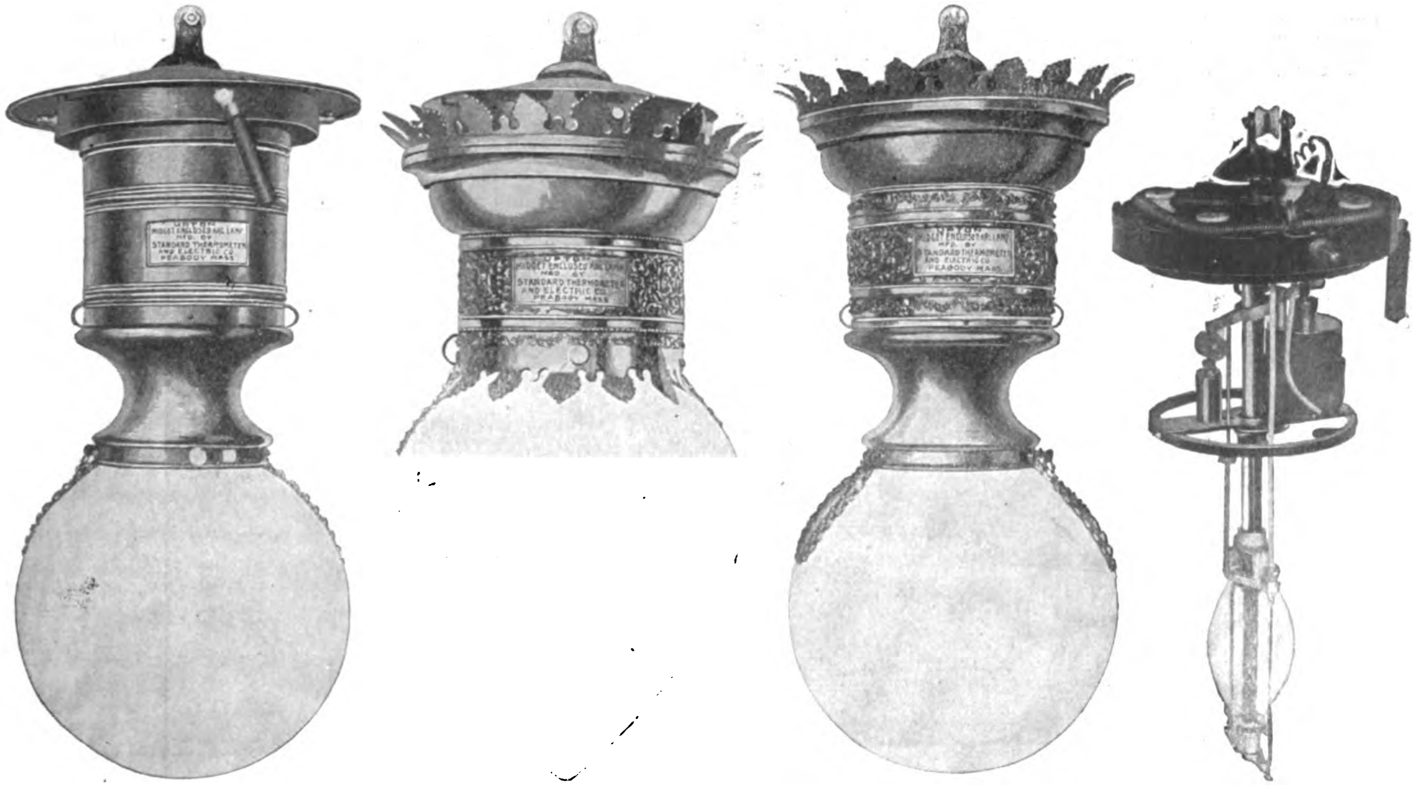
William Jay, George G. Ward, Sir William C. Van Horne, E. C. Platt, the Right Hon. Lord Strathcona and Mount Royal, Charles R. Hosmer, Thomas Skinner, Clarence H. Mackay, Albert B. Chandler and Dumont Clarke.

At the meeting of the directors which followed, the following officers were named: President, J. W. Mackay; vice-president and general manager, G. G. Ward; vice-presidents, C. R. Hosmer, A. B. Chandler and C. H. Mackay; treasurer, E. C. Platt; secretary, Albert Beck; assistant secretary, J. O. Stevens.

TRADE NOTES & NOVELTIES

Covers and Canopy Switch for "Standard" Enclosed Arcs.

THE accompanying cuts illustrate some of the different styles of covers which the Standard Thermometer and Electric Co., of Peabody, Mass., are using on their enclosed arc lamps. These lamps are designed for both indoor and outdoor service, the outdoor lamps being weatherproof and requiring no hood. They burn singly on 110 volt circuits and are provided with a device to adjust the arc for any voltage of line between 100 and 125. A very simple arrangement is also provided with the lamp enabling the user to adjust the lamp to take any number of amperes from three to six as may be desired without change of magnets. It will also be noticed that each lamp is provided with a switch placed in the canopy. If desired, however, these switches can be omitted in cases where the lamps are to be operated from wall switches. The covers of these lamps are finished in any style that may be required. The manufacturers of the Upton Midget Lamp claim that their lamp is the simplest on the market, having the fewest moving parts. A new catalogue has just been issued showing their enclosed arc lamps for all circuits which can be obtained from the main office or any of their agents.



STYLES OF COVER AND CANOPY SWITCH, "STANDARD" ENCLOSED ARC LAMPS.

MR. E. G. BERNARD, of Troy, was in New York City last week on important business.

Ferracute Machine Co.

The Ferracute Machine Company, of Bridgeton, N. J., manufacturers of presses and dies, have been very successful in their business during the last two years, and have kept a full force of workmen running through the dull times. Their foreign trade is increasing and they are constantly shipping machines to England, France and Germany. They have recently sent presses for notching armature discs to France, and also shipped a large double crank press to Budapest. This is the second large machine they have sent to the same factory, and they have supplied a number of the same style to the American factories. They make 120 different styles of double crank presses, with various forms of beds, and also a line of presses for light metal, which are used for cutting smaller discs. The company have recently issued circulars illustrating these machines, and will shortly issue a larger and more expensive catalogue than anything they have sent out heretofore.

Demand for the Willard Storage Battery.

Sipe & Sigler, manufacturers of the Willard storage battery, have been awarded the contract for 900 Willard cells for the city of Chicago, to be used in connection with their various fire alarm circuits. This contract was awarded after a competitive test with all prominent makes of storage batteries. They have delivered 58 cells to the Washburn Memorial Orphan Asylum, Minneapolis, Minn.; 64 cells to the Eclipse Electrical Co., St. Louis, Mo.; 80 cells to the American Incandescent Lamp Co., Warren, Ohio; 50 cells to M. A. Seed, St. Louis, Mo.; 28 cells to Prof. C. H. Wing, Ledger, N. C.; and 38 cells to the Riker Electric Motor Co., Brooklyn, N. Y. These batteries are to be used in connection with isolated plants.

For telegraph and telephone purposes, 100 cells have been sold to the Home Telephone Co., Cleveland, O.; 40 cells to the American District Telegraph Co., Cleveland, O., and several small orders to the Western Union Telegraph Co.

The horseless carriage trade is very brisk, and they have received within the past two weeks orders for 700 horseless carriage cells, among the purchasers being the Riker Electric Motor Co., Brooklyn, N. Y.; The United States Carriage Co., Chicago, Ill.; The C. H. Barrows Co., New York; Montgomery, Ward & Co., Chicago, Ill.; and the Gugler Electric Co., Minneapolis, Minn.

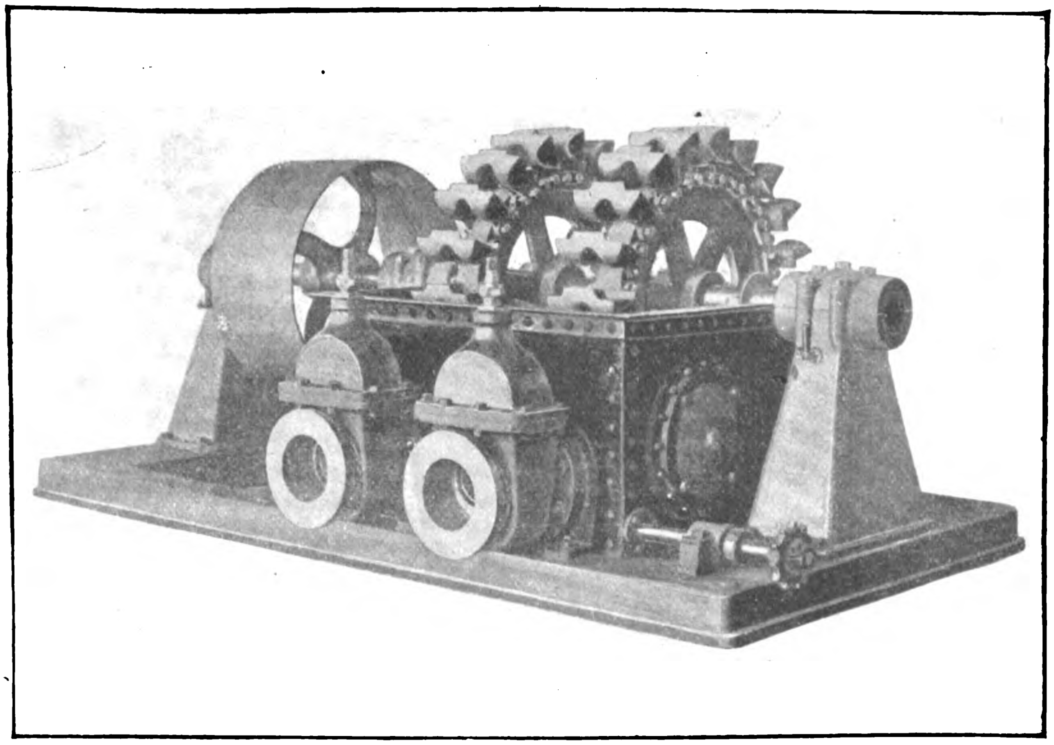
American Impulse Water Wheel in France.

A STRIKING example of the utilization of water power made possible by wheels of the impulse type, is presented in the arrangements recently made for power in the textile goods factory of M. Benoist Cadet Fils, at La Bastide, a town south of Bordeaux, in the Department of Tarn, France. Here a steam engine which formerly was used to furnish the power for the entire factory is now held in reserve for periods of low water, and the greater part of the time power is furnished by a 36-inch twin impulse wheel, working under a head of 128 feet at 285 revolutions per minute, and developing 40 horse power. The use of contracting nozzles makes a high efficiency possible with the varying loads. The accompanying illustration shows the wheel sent to La Bastide, by Messrs. Powell and Colné, export agents, Bowling Green Building, New York. It was furnished them by the American Impulse Wheel Company, 120 Liberty street, New York. The photograph was taken with the top casing removed and the shape of the buckets peculiar to this wheel can be observed. The design has been carefully worked out, and in this wheel as in all others made by the American Impulse Wheel Company, the mechanical perfection attained is of the highest.

The high efficiency of the wheels made by this company is due to the close attention and study which its engineers have given to every detail and to the great care exercised in manufacturing. A prime mover with so low a first cost, and almost negligible expense for repair and requiring little or no attention while running, is an attractive one to large numbers of manufacturers who are at present burdened with heavy expenses in connection with their motive power.

The possibilities of the electrical transmission of energy are now so great that many concerns might at comparatively small expense utilize water powers even though they be located at considerable distance from their establishments.

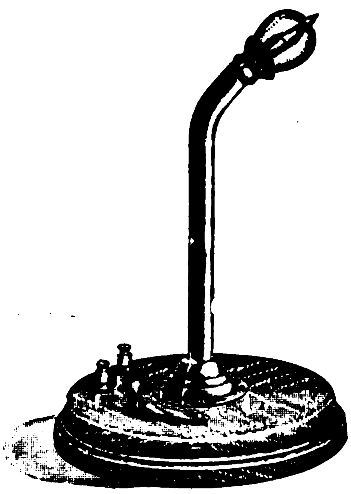
The numerous inquiries on such subjects which the American Impulse Wheel Company receive, have the careful consideration of their engineers, and as full information is sent in reply as the data presented will permit.



AMERICAN IMPULSE WATER WHEEL, AT LA BASTIDE, FRANCE.

AMERICAN RHEOSTAT COMPANY, of Milwaukee, Wis., reports that it is doing a very large business, and has recently shipped some noteworthy orders of rheostats to England, Belgium and Japan. It is also enjoying a large demand for Perfection starters from among the electrical contractors.

Mianus Battery Lamps for Sleeping Rooms.



A very handsome battery lamp has just been brought out by the Mianus Electric Company, Mianus, Conn. The claims in favor of an electric night lamp over an oil lamp which is smoky, emits carbonic acid and consumes the oxygen of the air, are undisputed. This electric lamp, which can be placed near the clock on a table, has a switch attached to its base and can therefore be lighted and extinguished at will. Dry batteries are used for the lamp, which will last a year without attention. The price of the outfit with a 4 c. p. lamp, without battery, is $1.50; with 4 cells of battery in a varnished hinged lid box, $2.50; and with 6 cells, $2.85. This box has binding posts so that wires can be run from posts on the lamp to posts on the box. The lamp may be used as a hall light or in any place where an occasional light is required.

Storage Batteries for Chicago Fire-alarm Service.

In accordance with his scheme to replace about 5,000 gravity cells with storage batteries to furnish current for the fire and police telegraph circuits of the city of Chicago, City Electrician Ellicott received bids on February 26 for 900 cells of secondary battery of 10 ampere hour capacity and 300 cells of 150 ampere hour capacity. The Police Telephone and Signal Company, of Chicago, offered to supply the chloride accumulators of the Electric Storage Battery Company of America for the whole outfit for $4,350; the American Battery Company, of Chicago, tendered the installation complete for $4,500, and Sipe & Sigler, of Cleveland, put in a bid of $1.20 each for the 900 smaller cells. All bids were furnished with the guarantee that the yearly cost of maintenance for the batteries should not exceed 7½ per cent. of the first cost. It is estimated that by replacing the existing primary batteries with storage cells, the city will save at least

$5,000 a year by reducing the expense of keeping up the plant.

The contract for the larger batteries was awarded to the American Battery Company for $3,150 and for the smaller cells to Sipe & Sigler for $1,080, making the total cost $4,230.

The Schlicht Combustion System.

The Schlicht system of combustion as applied to steam boilers, described in another column ought to be attentively studied by all central station men. Mr. P. J. Schlicht, its inventor, has hit upon a most novel plan of increasing coal economy and its simplicity is not its least factor of merit. The Schlicht Heat, Light and Power Company, of 27 William street, New York, have dozens of letters of testimonial as to the efficacy of their system.

"Not the Same."

The Warren Specialty and Electric Company, of Warren, O., write us: "It seems that some company who has a name similar to ours has been unfortunate enough to pass into the hands of a receiver. We, of course, sympathize with our namesake, but desire to inform the trade that while we have troubles, this is not one of them, and that we are still selling anti-trust lamps in large quantities."

A Few Striking Facts About Chloride Accumulators.

A circular has just been issued by the Electric Storage Battery Company as to the use of chloride cells, and we cull a few items:

35,000 h. p. hours are stored daily in chloride accumulators.

It is a significant fact that four of the central stations equipped with chloride accumulators have contracted for duplicate plants.

The largest single batteries in the world consist of 130 chloride accumulators of 9,600 ampere hours capacity operated in the service of the Hartford Electric Light Co., and 160 chloride accumulators of 7,600 ampere hour capacity in the station of the Philadelphia Edison Company.

19,000 chloride accumulators are in operation in telegraph, fire alarm and signal services.

Prices Paid for Electric Lighting.

The Fort Wayne Electric Corporation has rendered a public service by issuing a pamphlet, with the above title, giving full details for each place, inclusive of population, nature of power, cost of fuel, etc., schedule, candle power and number of lamps. It is a remarkably handy and useful little book.

ADVERTISERS' HINTS

THE K. & W. COMPANY, Pittsfield, Mass., manufacturers of the K. & W. commutator brush find that it is proving very popular, as in many places where trouble has been had with commutators the brush has overcome the difficulties most satisfactorily.

THE NATIONAL CONDUIT AND CABLE COMPANY, Times Building, New York, submit another letter attesting the excellence of their cables and cement lined ducts.

THE WORTHINGTON COMPANY, New York, say that it was only a few years ago that the Worthington Duplex pump patent became public property and many of the minor details of construction are still covered by patents belonging to them.

EUGENE MUNSELL & CO., 218 Water street, New York, advertise "Empire" insulated cloths and papers and "M-I-C" compound for armature coils and fields.

WM. E. KLINE & CO., 121 Liberty street, New York, have opened a Chicago office with Mr. W. R. Garton in charge at 414 Ashland Block, for the sale of their miniature and standard incandescent lamp, bicycle lamps and general lighting supplies.

THE CREFELD ELECTRICAL WORKS, 49 Federal street, Boston, Mass., have removed their New York office from 136 Liberty street, to 15 Cortlandt street.

GENERAL INCANDESCENT ARC LIGHT COMPANY, 7 Broadway, New York, advertise the new Bergmann alternating enclosed arc lamp for any frequency and with the same method of trim as the standard "D. C." lamps.

J. JONES & SON, 67 Cortlandt street, New York, advertise their automatic time cut-out for turning out window lights and similar uses.

C. F. SPLITDORF, 25 Vandewater street, New York, is well prepared to supply at short notice X-ray coils, telephone coils, bobbins and electro-magnets.

A. D. FRENCH, 44 Broad street, New York, furnishes octagonal poles, ties, cross-arms, conduit, etc. Prices may be obtained on application.

THE AUTOMATIC SWITCH COMPANY, Baltimore, Md., advertise solenoid, non-reversible, non-magnetic motor starters of which their catalogue contains a full description.

THE STANDARD THERMOMETER AND ELECTRIC COMPANY, Peabody, Mass., call attention to the Upton "Midget" enclosed arc lamp for constant potential circuits at 100 volts. This is but one of their many styles.

WE HARNESS THE LIGHT, say the Wheeler Reflector Co., Boston, Mass. This is by means of their different reflectors for various and special purposes.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., point out the noteworthy features of their direct current multipolar generators and motors.

THE GOLD STREET CAR HEATING COMPANY, Frankfort and Cliff streets, New York, illustrate a coil as used in the construction of their standard heaters.

THE ELECTRICAL BROKERAGE COMPANY, Elkhart, Ind., submit a list of bargains in dynamos, arc lamp clutches, pulleys, etc., etc.

THE CENTRAL TELEPHONE AND ELECTRIC CO., 1123 Pine street, St. Louis, Mo., advertise up-to-date telephones and switchboards with prices to suit the times.

THE FULLER COMPANY, Detroit, Mich., are building the mechanical draft fans for the Ypsilanti and Ann Arbor Railroad.

THE RIDGEWAY DYNAMO AND ENGINE CO., Ridgeway, Pa., claim to manufacture the only dynamo in the world which is provided with special coils for balancing armature reaction and securing perfect commutation with absolutely fixed brushes.

THE CRANE COMPANY, Chicago, have equipped over twenty large power houses during the past year with high-pressure gate valves, pipe and fittings.

THE WESTERN ELECTRIC CO., Chicago and New York, advertise no less than thirty varieties of batteries, wet and dry, also carbons, coppers, solutions, and all battery accessories.

THE CENTRAL ELECTRIC CO., Chicago, Ill., carry everything in the line of supplies and will handle orders both wholesale and retail.

K. McLENNAN & CO., 1128 Marquette Building, Chicago, Ill., on receipt of a coupon which may be clipped from their "ad," will send free a sample stick of Gale's commutator compound.

THE 1898 LUNDELL fan motors are now ready and include new styles and new prices which may be obtained by writing the Sprague Electric Co., 20 Broad street, New York.

MIANUS ELECTRIC CO., Mianus, Conn., say that both their telephones and prices talk, and we may add both make themselves heard.

LOMBARD WATER-WHEEL GOVERNOR CO., 61 Hampshire street, Boston, Mass., have installed over 70,000 horse power of their governors which are now in use.

B. F. STURTEVANT CO., Boston, Mass., build direct connected generating sets in capacities ranging up to 75 k. w. Their bulletin "C" contains detailed information.

THE CHARLES E. GREGORY CO., Chicago, publish a revised list of bargains, in which are mentioned many new items.

THE NON-POLARIZING DRY BATTERY CO., 625 Broadway, New York, publish a letter from the Pennsylvania R. R. Co., stating their batteries are all they are represented to be.

THE STEWART ELECTRICAL CO., Cincinnati, Ohio, are in line with a long list of bargains, including dynamos, motors, arc lamps, instruments, switches, carbons, etc.

SIPE & SIGLER, Cleveland, Ohio, give their reasons why the Willard storage battery is superior to all others.

STANLEY & PATTERSON, general electrical equipment supplies, 32 Frankfort street, New York, publish a letter rela-

tive to the excellence of the "Bohemian" coloring enamel and frosting for incandescent lamps.

DIAMOND STATE TUBE COMPANY, Elsmere, Del., manufacture fireproof and waterproof tubing for electric wiring of which they are glad to send samples and prices.

NEW YORK NOTES.

MR. A. D. FRENCH, of Broad street, New York, has placed upon the market a wooden octagonal pole, which is treated against decay by antiseptics, and is practically indestructible by rot. It can be substituted, he states, for iron poles at one-half the cost, and has as long life, while being cheaper to set up. Experiments extending over 35 years have proved its success beyond question. Such poles, even if they only outlast two untreated poles, will pay handsomely in the end, as the cost of labor alone in replacing a decayed pole, will more than offset the slight extra cost. A descriptive circular will be sent free upon application. Mr. French also handles the untreated octagonals, and reports a large trade this spring, but has ample facilities to fill all orders promptly.

MICA. "The rapid growth of our business is the strongest evidence of the superiority of our Mica," appears as a preface to the 1898 catalogue of "Mica" specialties which has been mailed to the electrical trade throughout the United States by Messrs. Eugene Munsell & Co., of New York and Chicago.

THE NATIONAL CONDUIT AND CABLE COMPANY, of New York, have been calling the attention of our readers through our advertising pages to some very interesting letters which they have received from a few of the large power transmission plants which they have recently equipped with their paper insulated underground cables, and which show remarkable tests. Among them are two letters from the St. Anthony Falls Water Power Company, of Minneapolis, mentioning a cable over nine miles long, which carried 18,000 volts alternating current for over eight hours. This cable is now in regular service, transmitting 2,000 h. p. nine miles by the three-phase 12,000 volt system. Another letter is from the Lachine Rapids Hydraulic Land Company, Limited, of Montreal, announcing that the paper insulated cables supplied to them, carrying from four to five thousand volts continually, have proved entirely satisfactory. Part of these cables cross the canal and are therefore lying in water all the time. These tests show the National cables to be of undoubted merit, and should be a source of congratulation to the company. In these days of severe competition between paper and rubber insulation for high tension cable purpose, they are particularly interesting.

MR. T. E. D. RITCHIE has just accepted a position with the Fort Wayne Lamp Company, of Cleveland, O., as Eastern sales agent and will have his headquarters hereafter in the offices of the Fort Wayne Electric Corporation, at 115 Broadway, New York. Mr. Ritchie has been identified with electrical interests for about nine years, during which time he has been connected with the Edison General Electric Company, and the Chicago Edison Company, and has recently been attached to the sales department of Sargent & Lundy, of Chicago.

MR. GEORGE T. HANCHETT, E. E., has established himself at 123 Liberty street, New York City, for the design and construction of electrical machinery and models, as well as for the preparation of engineering drawings, tracings, etc. He makes a specialty of perfecting inventions and apparatus.

FRINK'S CLUSTER AND WINDOW REFLECTORS are meeting with excellent demand throughout the trade. These goods have been known as standard for many years, I. P. Frink being one of the pioneers in the reflector business. The offices and salesrooms of I. P. Frink are located at 551 Pearl street, New York. Book of lights and estimates will be mailed free to any address on application.

NEW ENGLAND NOTES

CLINTON WIRE CLOTH COMPANY, Clinton, Mass., have the call on wire cloth and perforated metals throughout the electrical field. Their goods are used on dynamos and motors, to protect the commutators, for rheostats and for any other purposes throughout the electrical trade.

F. N. MANROSS, Forestville, Conn., reports business very good. Mr. Manross manufactures hairsprings for electric indicating and recording gauges, steam guages, etc., also non-magnetic hairsprings of phosphor bronze and other non-magnetic metals. Mr. Manross is the largest manufacturer of hairsprings in the United States and is in a position to manufacture any special goods to order.

THE K. & W. COMPANY, Pittsfield, Mass., has voted to increase its capital stock, the money to be used in adding to its equipment to meet the demand. The Hardy lamp proves popular and there has been a steadily increasing demand therefor and for the new type of Absolute Cut-Out Hanger Board.

COLUMBUS, O., wants bids up to March 24, on a municipal electric light plant, to include two compound condensing engines of 125 h. p. each, 500 r. p. m., or one 250 compound condensing engine, about 200 r. p. m., with condensers; two water tube boilers, 150 h. p. each, with straight tubes; one 125 lt. 2,000 c. p. arc dynamo; three 160 lt. 1,200 c. p. arc dyanmos; two 100 h. p. impulse or turbine water wheels; ninety 2,000 c. p. arc lamps; 310 1,200 c. p. arc lamps; 1,500 white cedar poles, peeled; 50 miles triple braided weatherproof wire; cross arms, pins, insulators, etc.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. MARCH 24, 1898. No. 516.

ELECTRIC LIGHTING

Two Commutator Dynamo at Hartman Carpet and Furniture Store, Chicago.

AN interesting isolated plant was started March 1 at the new store of the Hartman Carpet and Furniture Company on Wabash avenue, Chicago. It consists of a 60 k. w. double commutator Western Electric dynamo driven by a 14x14 inch Ball high speed engine. This dynamo, shown in Fig. 1, has a double set of armature windings and two commutators for the purpose of running both 110 and 220 volt circuits from the one machine. Each commutator gives 110 volts, and for lighting purposes the circuits are grouped so as to maintain approximately an equal number of lights on each side of the machine. For running the elevator motors the two 110-volt sides are connected in series to give 220 volts. The connection of the machine to the switchboard and circuits is shown in Fig. 2. The building is not wired on the three-wire plan, but has two independent two-wire circuits and a 220-volt power circuit. By suitable connections it can easily be run from the Edison three-wire street mains during the summer. Each commutator of the machine is connected to a double pole single throw switch which is connected to half of the 110-volt lighting system. Each commutator is also connected as indicated to a three pole single throw switch for the power circuit. When this switch is closed the two commutators are connected in series, but when it is open they are entirely independent. The balancing of the two lighting circuits is accomplished by wiring half of the lights on each floor to one side and half to the other.

The dynamo is compound wound. The shunt coils are run from one commutator, but the series coils are equally divided so

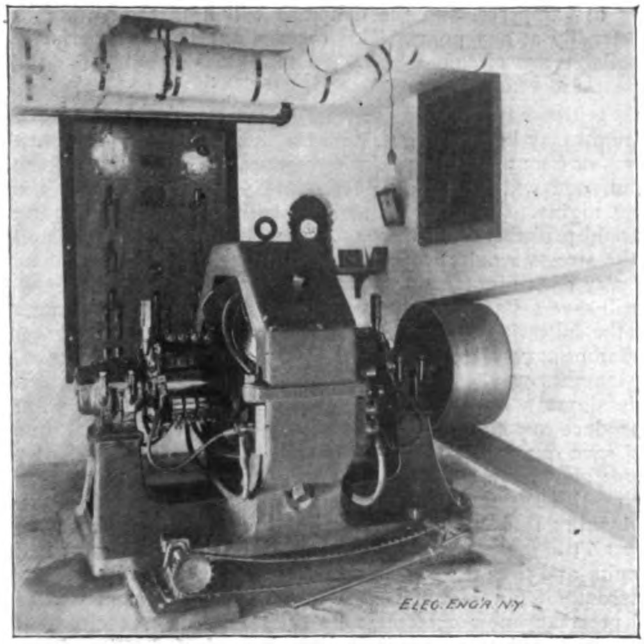


FIG. 1.—DOUBLE COMMUTATOR DYNAMO.

that half are run in the circuit from each commutator. Of course, whatever the machine compounds influences the voltage on both commutators, but with the load about the same on both sides this does not interfere with satisfactory working.

The building is wired for 629 incandescent and 46 Helios enclosed arc lamps. There are two Crane electric elevators, one for passengers and one for freight. The passenger elevator is rated to lift 2,000 pounds 250 feet per minute and the freight to lift 4,000 pounds 100 feet per minute.

The boiler plant consists of two 5x16 feet horizontal return flue boilers. It may be asked how a satisfactory service can be given with electric elevators and lights run from the same dynamo. This is provided for by making the engine somewhat larger than is necessary to drive the dynamo at its rated load.

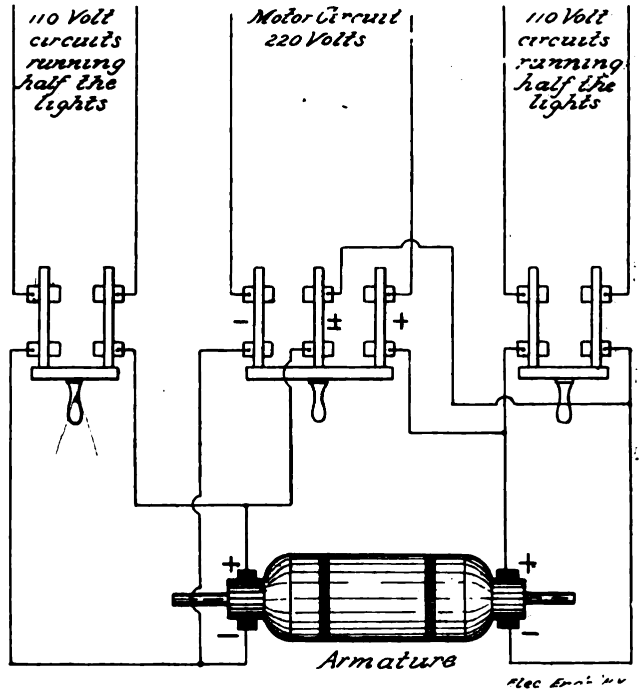


FIG. 2.—DIAGRAM SHOWING CIRCUITS FROM DOUBLE COMMUTATOR DYNAMO.

The engine gives 123 horse power at ¼ cut-off, while the dynamo is only 60 kilowatt.

The dynamo and switchboard were put in by the Western Electric Company, with F. D. Mack as consulting engineer.

High Tension Series Enclosed Arc Systems.

BY J. H. HALLBERG, E. E.

MANY articles have appeared in the pages of this journal describing the enclosed arc lamps and calling attention to their many advantages, but the writer has not seen any particular attention called to the high tension series enclosed arc lamps, which have now been perfected and are manufactured by a few firms. Probably the reason of this silence is that the manufacturers have not met with such success in designing and operating lamps on such circuits as would warrant this recommendation for street and commercial lighting.

I will first take up a few questions as to the requirements of the enclosed arc lamp for high tension series street lighting and commercial circuits. The insulation should consist of mica, lava and porcelain; fibre should never be used in arc lamps, except for switch handles. When testing insulation it is best that one should not depend on the ringing of a magneto bell, but should take one wire from the magneto in operation and connect to the ground, or to the frame of dynamo or cover of lamp; then, the other wire should be attached to a small handle and taken in one hand, while with the other hand touch some connection or bare wire in sure contact with the circuit; to be perfectly sure, the hands should be wet. It is understood, of course, that the operator must be insulated from the ground.

I have found this method to be the surest where no special testing apparatus is at hand, as one will surely feel the current from the magneto if there is a leak. One should never depend on ordinary insulation in high tension series lighting, as the extremely high pressure of the "kicks" caused by flashing of the dynamo or the breaking of a wire will break through any ordinary insulation; consequently, ground lamps and apparatus.

The lamps should be provided with a standard hanger and so designed that they will fit in the majority of hoods with hanger boards now in use. Each lamp should be provided with a cover that is easily removed for inspection. The lamp should be snow, rain and as nearly dust proof as possible and at the same time ventilated. All parts should be easily interchangeable with the use of no other tools than a pair of pliers and a screwdriver.

My experience has been that it is better to use binding posts and connectors than solder, for various reasons, the main one being that a coil can be changed without the use of a troublesome soldering iron. The cut-out should be positive in its action and have a sure adjustment, and its contact points should be easily interchangeable. It is preferable that the clutch should work directly on the carbon, as the wear of the clutch is thus reduced on account of the softness of the carbon. The lamp should be equipped with some device to prevent the slipping of the carbons. In a differential lamp the slipping could only happen during its burning, as the carbons are together during the day or when the lamp is not working. In a shunt wound lamp the device should always be in action, as the carbons in a shunt lamp are always apart except at the moment that the arc is struck. This device may seem unnecessary, but experience has proved that the best of clutches will slip in stormy weather, especially on lamps placed on tall poles, or if they are suspended from poles which also carry one or more trolley wires.

The inner globe should be easily interchangeable, as when trimming a number of lamps it is demonstrated that it is best to exchange the dirty inner globes for clean ones, and bring the dirty globes and what is left of the upper carbon back to the station, where the former are cleaned and the carbons are cut to the right sizes for negative or lower carbons for the next trimming. The lamp could be so designed that it would maintain the same voltage at the terminals and arc, whether the amperes be 4 or 7, varying, or any constant between these two numbers. A lamp designed for 4 amperes should operate on any ampereage between 4 and 7. The arc in the lamp should consume the entire voltage, as measured at hangers, except one volt. This one volt is all that is necessary to hold the cut-out open. When the lamp is cut out by its automatic cut-out not over 4 volts should be expended when the lamp coils are hot. The shunt coil and cut-out should not consume over one-tenth ampere when the lamp is hot.

If possible, the lamp should be so designed that no dash pot or springs are required in its mechanism. This is very important, as many readers have probably experienced more or less trouble from dirty dash pots, feed and cut-out springs. In many cases these lose their tension, which would either keep the lamp out entirely or destroy all adjustment, allowing the lamps to burn 30 to 70 volts instead of 45 to 50. The writer knows of some cut-outs that would not shunt the lamp until the arc reached about 140 volts. This, of course, would burn the shunt coils in the lamp, as they were only designed to stand a maximum of 70 volts. I believe all will agree that the spring and the dash-pot are the most frequent causes of trouble on a high tension street lamp, which is subjected to internal heat and to dust and dampness.

The lamp should be of light weight, say 25 lbs., complete with hood, hanger board and globe, so as to allow the use of lighter construction and suspensions; a light lamp will also make the old balancing weights unnecessary, and on shipments of lamps the freight is about one-half of that paid for old type long and heavy lamps. The lamps should be adapted for either inside or outside service without change; at the same time they should be so designed that if necessary the plain cover can be substituted for a fancy one without any changes on the lamp. The lamp should be as short as possible, say about 24 inches from top of hanger to bottom of globe, so as to allow the lamp to be used in low-studded buildings, basements and hallways. If it should be necessary to have a long lamp in order to suit some particular customer it can be done by simply putting on a longer cover without changing the mechanism of the lamps. The lamp should regulate so that its voltage would not vary over 5 volts at any time from normal.

The lamp that is designed and built so as to come up to the above specifications should certainly meet with the approval of most station managers and electrical engineers. Since the invention and perfection of the enclosed arc lamp it is possible to build a lamp of the type above mentioned, and the writer, after personally handling nearly 100 of them for street lighting purposes during the past ten months, has come to the conclusion that it is the most convenient street lamp and will surely occupy a prominent position among the enclosed arc lamps, as it possesses higher efficiency than any other type of enclosed arc lamp as yet advertised in this country. The light from the high tension enclosed series arc lamp possesses all the advantages that are so noticeable in the low tension d. c. enclosed lamp, which are, a perfectly steady light, perfect diffusion and distribution, the tint of which can be governed by the use of different combinations of globes. It burns from 100 to 150 hours with one 12x½ solid ("imported") carbon. This not only saves labor in trimming and attention, but the lamp mechanism and clutch do not wear, as the lamp feeds only a few times every twelve hours. It must also be remembered that the clutch works on the soft carbon, which prevents it from wearing, and as there are no carbon rods the repairs on an enclosed arc lamp are only about 10 per cent. of that for the open arc system.

If we now get a lamp as per above suggestions it would be perfectly proper to ask the following question, if one does not already realize the economy of a plant equipped with this type of lamp for street lighting: How do these lamps compare with the open arc system in regard to amperes, voltage and candle power? The old type open arc lamp requires 10 amperes and 45 to 50 volts (equal to 450 to 500 watts) to produce what is known as 2,000 nominal candle power. The new enclosed arc lamp with clear globes requires 7 amperes and about 71½ volts (equal to 500 watts) to produce 2,000 nominal candle power. From the above figures it can be seen that the wattage remains the same for both types of lamps; consequently, the coal bill is not increased when one uses the enclosed series lamps. The enclosed arc lamps require about 20 per cent. higher voltage, but the amperage may be reduced accordingly. I consider this a great advantage, especially if the circuits are very long, as the line loss would be cut down considerably. If 1,200 candle power system is desired, the wattage consumption would be about 300 to 325 (equal to 4 amperes and 80 volts, or 5 amperes and from 68 to 70 volts). I mentioned in the early part of the article that a shunt wound high tension series enclosed arc lamp could be so designed that it would operate with the same arc voltage, even though the amperes vary about 40 per cent. The advantage of this will undoubtedly be seen. To-day almost any manufacturer of arc dynamos will furnish regulators and controllers, by the adjustment of which the amperage may be changed from, say 4½ to 6½ amperes, and the dynamos will hold their amperes very steadily at any point. This enables one to get a perfectly controllable arc circuit, which may be varied at will from the station.

On dark nights the dynamo may be run at 7 amperes. The next night may be moonlight, then the dynamo can be cut down to say 5 or 6 amperes; then, during winter, when snow is on the ground, one will not need over say 5½ amperes during the darkest nights. On moonlight nights with snow on the ground one could probably go as low as 4½ amperes on the circuit and still the streets would be equally well lighted as they would be on a very dark night with 7 amperes. This feature of this system will save a station or a town a good many dollars. Figures show the following:

200 lamps at 70 v. each = 14,000 v. $\times$ 7 amp. = 98,000 watts.
200 lamps at 70 v. each = 14,000 v. $\times$ 4½ amp. = 63,000 watts.

This shows a saving of 35,000 watts per hour. If the plant can produce one electrical h. p. per hour with 4 lbs. of coal, one would save during an 11-hour run on 4½ amperes instead of 7 amperes about one ton of coal, equal to say, about $2.00. By applying this system I am sure a great many plants which now shut down at 12 p. m. could persuade the town which they light to pay a little more and run on a very low amperage the rest of the night, and then it might be profitable to run an all-night incandescent circuit. I am sure lighting plants in small towns could get many new customers on their incandescent circuit if they could afford to run until daylight instead of shutting down at 12 p. m. These are only a few examples showing the many advantages that can be gained through the use of this system There are many stations which have 4 to 7 ampere dynamos that are not in use, for, as the town grows, the requirements change, a larger light is wanted and a 10 ampere arc system has to be put in. Now, clean and fix up the old 4 to 7 ampere dynamos and write for prices and information to arc lamp manufacturers who make a high tension series enclosed arc lamp. Be sure that the manufacturers guarantee the lamp to burn on a varying amperage of say, about 3, without change in the voltage at hangers, as the old type dynamo may not regulate as well as

the later designed and improved types. So it is seen, if the town board should vote to put in 15 or 20 new 2,000 c. p. arc lamps, and the present 10 ampere dynamos are loaded, one can, if an old 6½ ampere dynamo is on hand, by simply buying this type of lamp and putting up new circuits, furnish this town with this lamp and save the cost of a new dynamo.

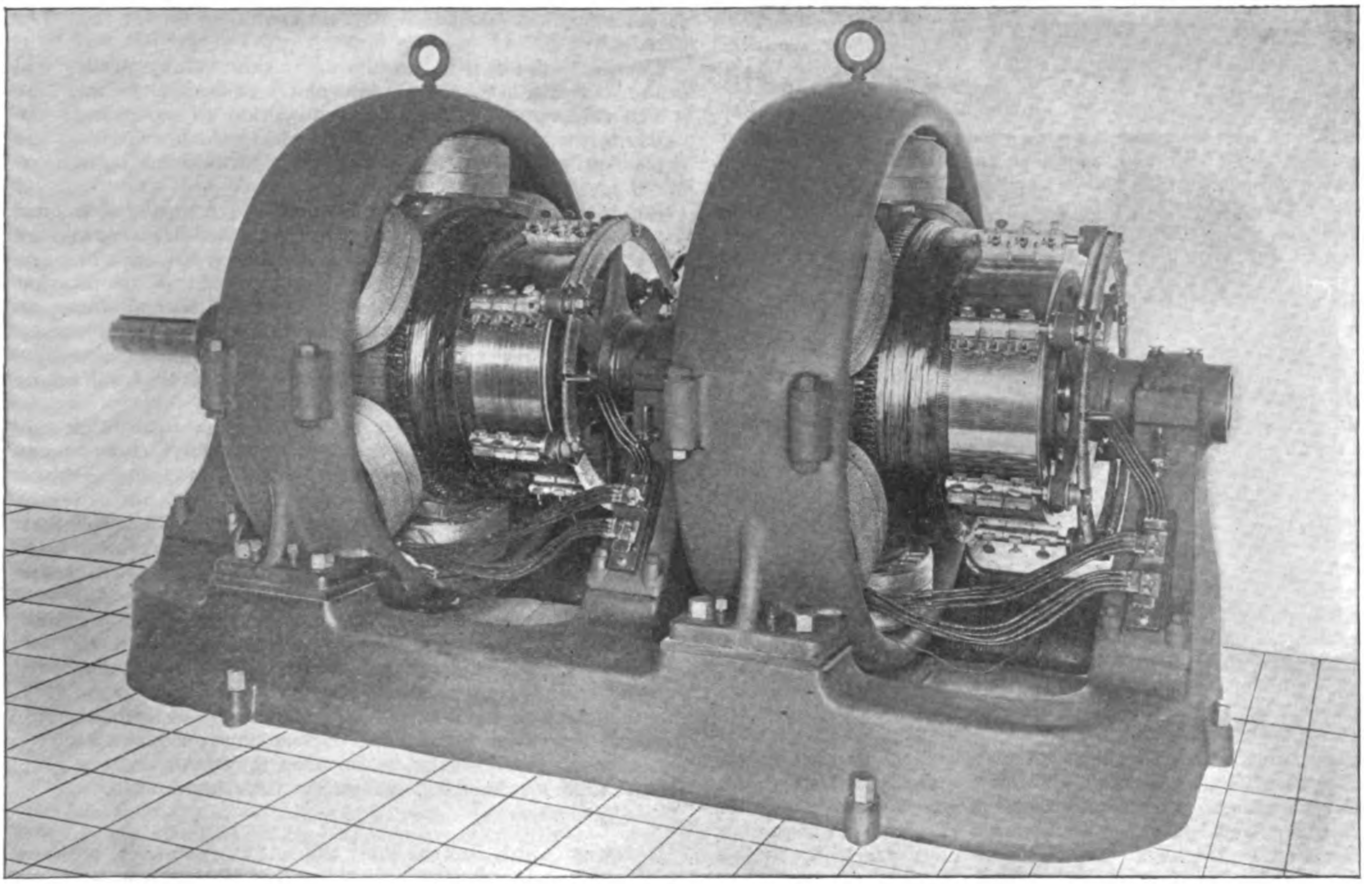
The foregoing explanations and suggestions might alone show station managers how they would profit by the use of an arc lamp of this type, but I will now call your attention to the most important fact, and that is, that this lamp operates for 125 hours without any attention or trimming. At each trimming there is only used one 12x½ ("solid imported") carbon. The cost of this quality of carbon is between $27.00 and $30.00 per 1,000; consequently a lamp of this kind, if operated 10 hours every night in the year, will consume 30 of these carbons per year, equal at highest carbon price to 90 cents. If the carbon for the old type open arc lamp cost $15.00 per 1,000 pair, delivered (this is certainly the lowest cost figure), then a lamp of that type which consumes one pair of carbons each night of 10 hours, requires 365 pair for one year, equal to $5.47½, and making a saving of $4.57½ each year per lamp in carbons alone.

As the enclosed arc only needs trimming once every 10 or 15 days, one or more trimmers may be dispensed with. The enclosed arc having an inner globe, a deduction of about $1.00 per year for each lamp might be made from the above figures to allow for the additional chances of breakage.

Special 220-Volt American-Ball Generator.

THE accompanying half tone represents a special generator of 150 k. w. capacity, just designed and built by the American Engine Company of Bound Brook, N. Y., for the Crookston Water Works at Crookston, Minn., where it will be driven by a turbine shaft through a friction clutch coupling, running at 300 revolutions per minute, and used for supplying direct current to a three-wire system. As will be seen, the generator consists of two dynamos on a single base and having a common shaft, making a very compact combination.

This machine is required to run at a very low temperature, and without any brush movement, and has been designed to meet the most exacting requirements.



150 K. W. 220-VOLT GENERATOR, TWO MACHINES ON A SINGLE BASE, AND HAVING A COMMON SHAFT.

TELEPHONY AND TELEGRAPHY

Telephone Bill Argument at Albany.

AT the second committee hearing on the Brush telephone bill, to regulate and nominally lower rates in New York State, on March 10, at Albany, Mr. U. N. Bethell, general manager of the New York Telephone Company, made a most convincing argument in opposition to the passage of the bill. He showed that it was defective and loosely constructed, and that it was very feebly supported, there being no demand for its passage from any large body of telephone subscribers from whom support might naturally be expected were the measure a proper one. In explanation of this lack of support, Mr. Bethell gave a sketch of the progress of the New York telephone system under message rates, which effectually opened the eyes of the committee to the defectiveness of the Brush bill and to the inexpediency of interfering with the telephone exchange industry as it is now conducted in New York State. At the beginning of 1895 there were 10,396 exchange stations in New York City, practically all at various flat rates. The message rate system had been introduced tentatively in 1894 and at no time had all the subscribers, or nearly all, paid the $240 rate for unlimited service, which is the only price the supporters of such bills as the Brush ever mention. From 1895 to 1898, the New York system under the active development of the message rate scheme had had a remarkable growth. The gain in subscribers from the beginning of the company's existence up to 1895, a period of 16 years, had been 10,396 stations. The gain from 1895 to 1898, a period of three years, had been 11,199 stations, or about 110 per cent. At the end of 1897 there were in New York City, 21,595 exchange stations and a total of 23,865 stations of all classes, exclusive of those in the company's central offices. This marvelous growth continues, for in January and February of the present year there had been a net gain of 1,071 exchange stations. Such an unparalleled increase,

equaled by no other telephone system in the world, could only be accounted for on the supposition that the customers of the telephone service were satisfied with the present charges. Those charges were based on a minimum rate sufficient to meet the fixed expense of the plant and force necessary to render a minimum amount of service, and on a subsequent charge varying with the amount of service used by each station.

Mr. Bethell reviewed in detail the arguments that had been made in favor of the bill, the bill itself, and the history of the New York telephone system. He showed that the principal speakers in favor of the bill, who appeared only to advertise themselves or to justify their existence as officials of busybody associations, while disingenuously declaiming against the $240 rate, as if that were the only price at which telephone service could be had in New York, actually took service themselves at message rates, and being people in a relatively small way of business, only paid about $120 to $130 a year for their service. The bill itself was loosely prepared and had not been amended to meet the objections scored against it at its previous appearances—it had not even been amended to conform to the different conditions arising from the creation of the new city of Greater New York. It was further open to the grave legal objection that in forming a commission of State officers to regulate rates, it imposed judicial functions on executive officials sworn to the performance of entirely different duties in the service of the State. From a practical telephone point of view, the bill attacked the interests both of the telephone companies and of the subscribers. The bill imposed a maximum rate, and a maximum rate meant really a flat rate; for the message rate system meant that users paid according to their use, and consequently it could not be worked in connection with a maximum rate. Some 85 per cent of the New York stations pay an average rate below that imposed by the Brush bill. The Brush bill would enable the company to charge subscribers who make small use of the service more than they now pay, for the benefit of the large users, who would pay less. But what would the result be? No law can compel a man to take for $125 that for which he now pays $90 or $100. Many of the small users would give up the service—which they need, or they wouldn't take it—and the company's business would be thrown into confusion. The bill would therefore be inimical to the interests both of the subscribers and of the company. The figures previously quoted showed that the company was making every legitimate effort to extend its business at rates that were equitable and just, and the doubling of the system in three years was equivalent to a certificate on the part of the public to the correctness of the company's policy.

In dealing with the comparisons with foreign cities, made by those who spoke in favor of the bill, Mr. Bethell pointed out that the figures they quoted were invariably inaccurate, and that they also omitted to mention the much lower charges obtaining in Europe for labor, material, rents, wayleaves, rates and taxes. Also that the service was generally inferior, as all American travelers knew, and that the subscriber was usually constrained to contribute to the capital account in some way or other, either by payment of an installation charge equal to a year's rental, or by providing his own instruments and part of his line, or by paying his rental annually in advance. American companies did not practice such methods, and a detailed comparison would show very different results from those that might be deduced from the loose statements of the supporters of the bill.

A Report Against the Pacific Cable.

A dispatch from Washington states that Representative Corliss, of Michigan, has completed the minority report of the House Committee on Interstate and Foreign Commerce against the bill reported by that committee for the establishment of a Pacific cable. The original bill provides for a subsidy to the Pacific Cable Company at the rate of $100,000 a year for 20 years, and provides for the completion of the cable to Honolulu by 1900, and to Japan and China by 1901. The substitute offered by Mr. Corliss and Mr. Fletcher, of Minnesota, also provides for a subsidy not exceeding $100,000, but it eliminates the name of the corporation, and has a provision for advertisement by the Postmaster General and the co-operation of the Government of Japan. The report indorses the proposition of a cable, but objects to the bill of the majority because it grants an exclusive monopoly, a subsidy of $2,000,000, and holds that all franchises should be open to competition. It also says that another American corporation is ready to enter into a contract to construct the cable. The report continues: "It is well known that Japan stands ready to grant a like or greater subsidy for the construction of this cable, in addition to the subsidy proposed in these measures, and it is believed that for the public good the President should be clothed with power to secure the co-operation of Japan for the construction and maintenance of this important public work, and the minority therefore submit an amendment authorizing such action, with the expectation that such co-operation and competition will result in securing the establishment of a cable at a much less figure than it is proposed to grant to the Pacific Cable Company by the measure submitted by the majority of the committee."

Practical Features of Telephone Work—II.

BY A. E. DOBBS.

STARTING THE NEW EXCHANGE.

In beginning the work, the "new company" will have one advantage, viz., the support of the people, provided they can be convinced that the newcomer means business. Rightly or wrongly there is considerable prejudice against the older company, and most communities would welcome competition; for the old theory that the telephone business is a natural monopoly, has no more foundation in fact than in regard to railroading, telegraphy or electric lighting, and an active solicitor will not only secure many of the old company's subscribers, but will add a host of others who could not be reached at old-time prices. Some business men will, of course, regard two telephones as a nuisance, but their attention must be called to the fact that they can reach about twice the number of subscribers at the same price they formerly paid for one instrument, and that competition insures better service, and to a certain extent a duplicate service, in case of trouble on one or the other lines.

Another point worth considering is this: Many parties will desire to retain both the old and new telephones. In this case it is an advantage and an accommodation to so arrange the numbers that business men in advertising do not have to use two sets of numbers. In other words, give them the same number they already have.

But it will not do to forget that the old company will meet the cut rates; that it has, or will have, first-class equipment, and men who know how to handle it; that it has, or will have, first-class instruments and long-distance connections—this latter being a very distinct advantage, until the new toll lines can be built—and while people may put up with indifferent service for two or three years, for the sake of having competition, the one giving the lowest rates and the best service will finally secure the bulk of the business.

Scattered throughout the country are many towns that will support exchanges of from 50 to 500 subscribers, and it is to these we will first turn our attention; it is exchanges of this size that are most in need of advice, as larger ones generally make it a point to secure fairly good engineering talent. First secure a superintendent, or foreman, who understands his business and give him entire support as long as he is worthy, and be sure that he is broad-minded enough to employ good men to do the work. Line and exchange work is an art that cannot be learned in a week. I know of one exchange that had a very costly experience. Owing to the narrow-minded jealousy of the superintendent, the work was done by green men; so much so that it became pretty well understood that a good lineman could not hold a position there. The owners however found him out and let him go eventually, since when they have spent a great deal of money rebuilding, that might have been saved.

WIRE.

In towns of this size the lines will not average over, perhaps, ¾ of a mile in length, and well galvanized steel or iron wire will answer every purpose. In New York and the New England States, wire the size of No. 12 B. W. G. should be used—though many companies use No. 14. In States not visited by severe storms, No. 14 answers every purpose.

If I remember rightly, the old Western Union test of galvanized wire was to plunge the end into strong muriatic acid four times, withdraw it quickly, and wipe it off each time. If blackened after the fourth plunge it was not considered satisfactory, but if the zinc coating still remained bright, the wire

was passed. This test, however, is a severe one, and was probably adopted because the W. U. wires generally follow railroad lines, where smoke and steam are hard on them. Good, ordinary No. 14 steel wire will stand three plunges, but not always the fourth. If it will not stand three plunges, do not buy it at any price.

Wire bought from firms who make and advertise telephone wires, will generally stand this test. Still, as it only takes five cents' worth of muriatic acid to make this trial, the buyer does not have to take anybody's word as to the quality.

Now, in advising the use of iron wire for grounded, or common return lines, we will, no doubt, run counter to some of our young friends who will ask: "Is not copper a better conductor than iron?" "Does it not possess less self-induction?" "Will it not last longer?" "If it is the best, why not use the best?"

Stop a minute, and let us do a little thinking. Iron or steel wire, sizes No. 14 and No. 12, B. W. G., can be bought at from $3 to $6 per mile, while No. 12 B. & S. copper, which is certainly small enough, will cost about $15; quite an item in a bill for several hundred miles. Then while iron wire requires only 33 poles to the mile, copper will need about 40; another little item worth considering. Iron again, does not require such care in handling, so that the men can make better time putting it up. It is true that its self-induction is greater than that of copper, but with the apparatus in common use the difference cannot be distinguished up to five or six miles. It is well known that induction coils of 250 ohms are made to transmit clearly over from 2,000 to 4,000 ohms of line resistance, and it requires no great mathematical ability to discover that 50 or 100 ohms difference in resistance will make no difference in the volume of sound perceptible to the average ear. Then again in a common return system, the resistance of the iron wire is an advantage in allowing a smaller return wire to be used.

Iron wire wears out; so does copper. To be sure, copper can be sold for junk, and it is also true that it is frequently stolen. Iron wire will last five or six years and can be renewed at any time; besides, conditions will change; for it often happens that pole lines, expected to carry only a few wires, become loaded down, and vice versa. Then, at the end of five or six years, when most of the wires and some of the poles need renewal, the managers will have had experience enough to deal with conditions as they then exist.

Since the use of iron wire does not necessitate poor work, is a great deal cheaper, and since except for very long lines it is practically just as good, why not use it? There is a time when cheap line material will answer every purpose; as there are conditions that require the best of everything. Therefore save money on wire and high priced insulators, and put it into some other part of the plant.

Of course there are systems that require copper wire and metallic circuits in exchange work, but these are special systems, and they require special treatment. Sometimes, however, it is deemed advantageous to call the attention of the public to the fact that iron wire has been discarded. Even in that case three or four dollars a mile can be saved, by using the Roeblings' bi-metallic wire. Theoretically it seems better than either copper or iron alone, for grounded, or common return systems. Though it has only about 67 per cent. of the conductivity of copper, the manufacturers claim that for grounded circuits it gives as good results as copper, section for section, which may be due to the fact that alternating currents of high periodicity travel on the surface, and do not penetrate deeply into the metal at their first impulse, and it is possible that the self-induction and resistance of the steel core confines the current more largely to the surface, preventing what is called the skin effect, in retarding transmission. It stands the weather as well as hard drawn copper, and the steel core gives added strength, therefore requiring fewer poles. There are local telephone companies using a considerable quantity of it.

ALUMINUM CONDUCTORS.

I learn that for electrical conductors the Pittsburg Reduction Co. are prepared to put aluminum wire on the market at a price that will make it cheaper than copper, section for section. It is very light, a mile of No. 12 B. & S. weighing only 32 pounds. It will stand the elements as well as copper, and has the same freedom from self and earth induction, and as a conductor is far superior to iron and has about 63 per cent. of the conductivity of pure copper. These are points at least worth considering.

MECHANICAL

The Gas Composimeter.

THE gas composimeter is a new instrument, which, as the name implies, measures the composition of gases. It automatically and continuously samples, indicates and autographically records the per cent. of the desired constituent, thus producing a continuous and true record of such constituent, as it occurs at any moment in the gas mixture sampled.

The principle employed is applicable to the determination of any absorbable constituent of a gas mixture; but the form herein illustrated is especially designed for the continuous determination of carbon dioxide, or carbonic acid gas.

Every combustible constituent of fuel requires a definite amount of oxygen for complete combustion, and produces a definite quantity of heat. This heat is absorbed by the products of combustion and the surrounding objects. Carbon constitutes from 50 per cent. to 95 per cent. of all industrial fuels, whether

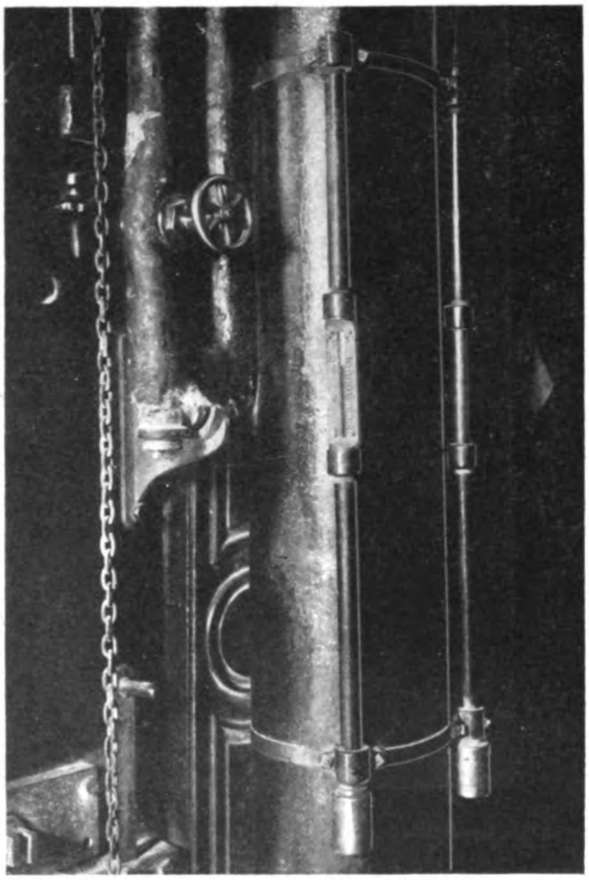


FIG. 2.—COMPOSIMETER INDEX FASTENED TO COLUMN IN FRONT OF A BOILER.

solid, liquid or gaseous. Combustion consists in the act of chemically combining the fuel elements with the oxygen of the air. The natural effect and general object of combustion is heat. Confining ourselves to the principal fuel element, carbon, we have the fact that it has two stages of combustion. In the first stage one atom of carbon combines with one atom of oxygen and forms one molecule of (CO) carbon monoxide. This molecule of CO unites with another atom of oxygen forming (CO_2), carbon dioxide, completing the combustion of the carbon.

Atmospheric air which consists of 23 per cent. of oxygen and 77 per cent. of nitrogen, a small per cent. of carbon dioxide and a variable quantity of moisture, furnishes the oxygen for all ordinary combustion. In the first stage of combustion one pound of carbon combines with 1⅓ pounds of oxygen and forms 2⅓ pounds of carbon monoxide gas, mixed with 4½ pounds of nitrogen, producing 4,400 heat units, which quantity of heat is

capable of evaporating 4½ pounds of water from and at 212 degrees.

The carbon monoxide thus formed is capable of uniting with another equivalent of oxygen, and for each pound of carbon an additional 4½ pounds of nitrogen are brought in with the required oxygen from the air, forming 3⅔ pounds of carbon dioxide mixed with 9 pounds of nitrogen, producing 10,100 heat units capable of evaporating 10½ pounds of water from and at 212 degrees. Complete combustion of one pound of carbon therefore requires in round numbers 12 pounds of air, resulting in 13 pounds of products of combustion, producing 14,500 heat units which is theoretically capable of evaporating 15 pounds of water into steam from and at 212 degrees.

It is thus evident that it is of the utmost importance that sufficient air must be furnished to provide the oxygen necessary for complete combustion. On the other hand it is no less important that an undue excess of air be avoided. In the one case fuel in the form of carbon monoxide is permitted to pass out at the stack, in the other the heat generated by combustion is absorbed by the excess of air and is carried out at the chimney, reducing the useful effect of the fuel. If the exact amount of air could be given to burn carbon completely the products of combustion would contain 21 per cent. of carbon dioxide, and the greatest possible efficiency would be attained. In practice this perfection cannot be realized and to avoid the loss by the formation of carbon monoxide, an excess of air is always given. Since the quantity of air required to furnish the oxygen necessary to completely burn one pound of carbon is always the same, it is evident that the percentage of carbon dioxide must decrease as the excess of air increases.

Every cubic foot of air not required for combustion that passes through or over the fire carries with it its quota of heat, which is wasted up the chimney. The excess should therefore be regulated to a minimum. A well stocked and regulated fire should form no appreciable amount of carbon monoxide with an excess of 30 per cent. of air. This amount would give 16 per cent. of carbon dioxide in the products of combustion and yield 93 per cent. of the efficiency that complete combustion without an excess of air would give. Under these conditions, allowing the gases to pass up the chimney at 525 degs., there is an unavoidable loss of 7 per cent.

An excess of 60 per cent. of air gives 13 per cent. of carbon dioxide and means a loss of 13 per cent., of which 6 per cent. is avoidable. An excess of 100 per cent. gives nearly 10½ per cent. of carbon dioxide and means a loss of 20 per cent., of which 13 per cent. is avoidable. An excess of 150 per cent. of air gives 8¼ per cent. of carbon dioxide and means a loss of 31 per cent., of which 24 per cent. is avoidable. An excess of 200 per cent. gives only 7 per cent. of carbon dioxide in the products of combustion, which means a loss of 40 per cent. up the chimney, of which 33 per cent. can be saved, on the basis underlying all these calculations, which is, that 30 per cent. of excess of air is sufficient and that the stack temperature is 525 degs.

Complete combustion of the carbon can be attained with considerably less than 30 per cent. excess of air, and a greater excess does not insure the absence of CO in the products of combustion. An uneven fire will produce CO in any case, and the products of combustion will show low in CO_2 at the same time. The percentage of CO_2 is therefore the best measure of the economical condition of the fire.

Fig. 1 illustrates an equipment of a system of sixteen instruments for measuring carbonic acid, as installed in a large boiler house and in full operation. To the right are the composimeters, and to the left the recording gauges, one for each boiler in a battery of sixteen.

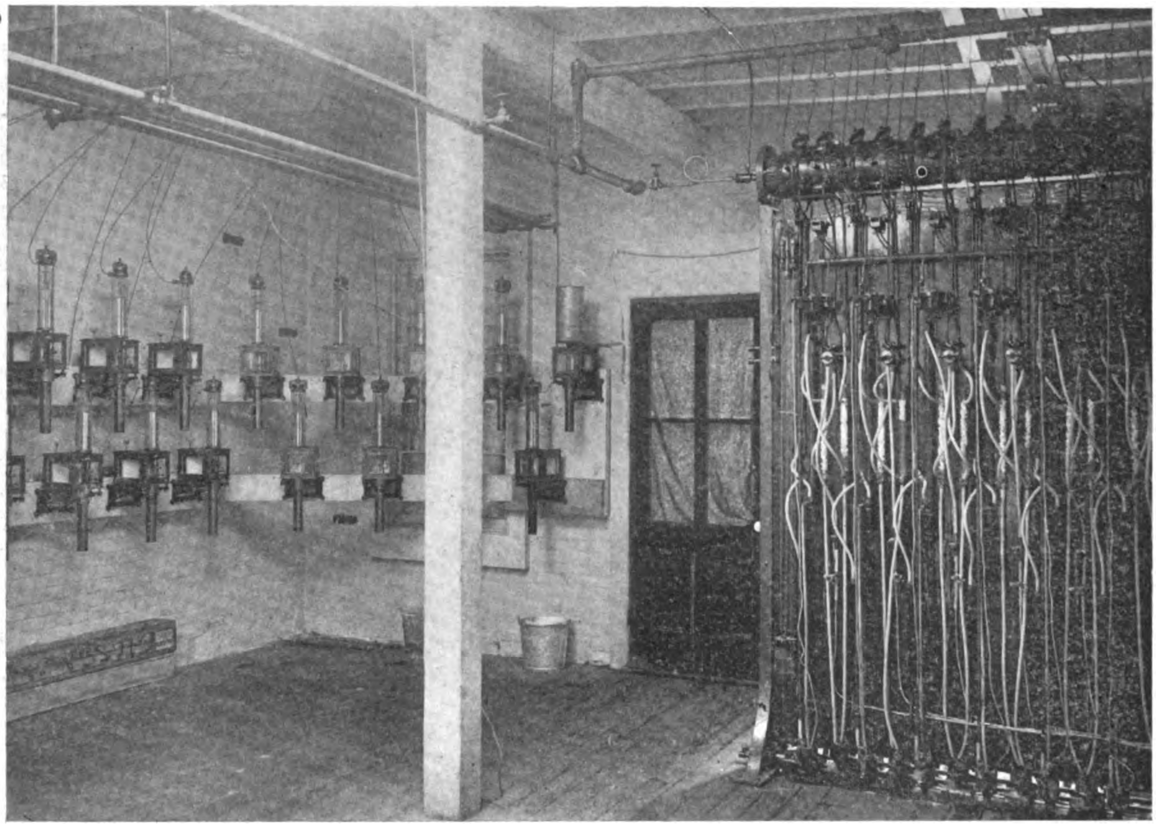


FIG. 1.—EQUIPMENT OF SIXTEEN COMPOSIMETERS AND RECORDING GAUGES IN A LARGE BOILER HOUSE.

Fig. 2 shows the index fastened to a column in front of the boilers, in plain view of the fireman, showing him at all times the condition of his fire, and enabling him to regulate his fuel bed and draughts, so as to attain maximum efficiency.

Figs. 3 and 4 are fac simile of autographic records (scale ½ size) made by the gas composimeter and also of the pneumatic pyrometer. Fig. 3 shows three 8-hour records. A is from an ordinary return flue boiler, running under light loads and natural draught. B is from a sectional safety boiler working under full load with natural draught. C is from a return flue boiler, driven to the fullest capacity with an air pressure ⅜ of an inch of water under the grate. Omitting the noon hour in A and the intervals for cleaning fires, A shows an average percentage of CO_2 not over 9 per cent.; B shows fully 10 per cent., and C 15 per cent. of CO_2.

Under these conditions of combustion, allowing a stack temperature of 525 degrees and assuming that carbon is the fuel and

that no appreciable amount of carbon monoxide passes off with the products of combustion, record A indicates a loss of 27 per cent.; record B a loss of 22 per cent.; record C of only 8 per cent. due to excess of air, all within the range of possibility to avoid. The products of combustion producing record C contained less than half of 1 per cent. of CO.

B B, Fig. 4, is a reproduction of B, Fig. 3. A A is an autographic temperature record, showing the heat of the furnace about 6 inches below the boiler, and directly over the grate. The sudden drops in the temperature are caused by the cold air rushing in when the fire door was opened for the purpose of coaling up or cleaning fires, which operations are perfectly recorded, both as to the time and duration. The cold air rushing in not only reduces the temperature in the furnace, but at the same time dilutes the products of combustion and hence the per cent. of CO_2 to be correct must drop with the temperature. The perfect accordance of the records which were simultaneously taken is proof of the correctness and fidelity of both.

The value of such an instrument will be highly appreciated by engineers and superintendents of works who have been laboring with the ordinary analytical methods to determine the CO_2 in chimney gases, for the purpose of controlling the fireman with a view to economizing fuel. By the aid of this instrument the economical condition of the fire is continually before the eyes of the fireman. When the indication of the carbonic gas falls below the economical per cent. it means that the fire is getting too thin and must be replenished, or that it has holes through it and must be attended to.

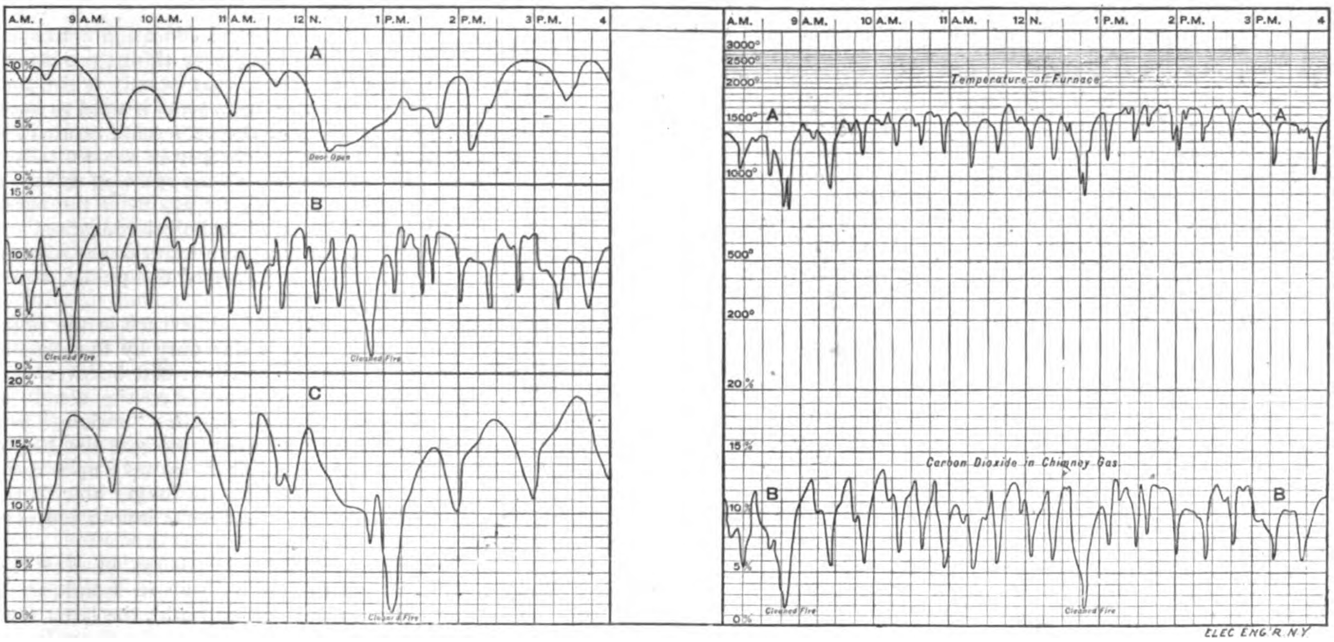
From the autographic record the engineer or superintendent can always see how well the fireman attended to his duty all through his turn, as well as at any particular hour or minute. It shows how often he fired, how long the doors were ajar, when the fires were cleaned, and what time was consumed in cleaning. It furnishes unbiased data by which to compare the work of different firemen, and results of one day's work with another. Different methods of firing can be tested without trouble and the best method adopted.

Few people have any idea of how much fuel is wasted up the chimney because of inefficient and careless firing. There is probably not one boiler plant in a hundred in which at least 5 per cent. of the fuel could not be saved by the intelligent use of the gas composimeter, and there are many plants where from 15 to 20 per cent. could be saved on the coal bills.

The gas composimeter is especially valuable in connection with plants equipped with mechanical stokers and forced draught or blast. The percentage of carbon dioxide in the products of combustion being continuously in sight, the stoking apparatus can always be regulated to the point of best economy.

The gas composimeter as illustrated may be placed in any suitable position within 100 feet from the boiler to which it is attached.

Further details and information on this interesting apparatus may be obtained from Messrs. Uehling, Steinbart & Company, 61 Mulberry street, Newark, N. J., who manufacture both the gas composimeter and the pyrometer.



FIGS. 8 AND 4.—FAC SIMILE OF AUTOGRAPHIC RECORDS (SCALE ½ SIZE) MADE BY THE GAS COMPOSIMETER AND PNEUMATIC PYROMETER.

EDUCATIONAL

Technical Education.

A VERY able address on the above subject, of which the following is an extract, was delivered by Prof. W. E. Ayrton, F. R. S., to the students of the Coventry Technical Institute, the occasion being that of the distribution of prizes. He said: The object of technical instruction is to enable a person to apply himself with advantage to some industrial pursuit. Such instruction may now be obtained at very many technical schools throughout the country, and in a much less formal way a large amount of technical information can, of course, be picked up in a factory by an intelligent person.

The ideal technical school would be one attached to the works, in which the employé would be systematically taught their trade, the application of the principles of science to their particular industry, and so forth, in somewhat the same sort of way that in former times the few apprentices were taught the "mysteries of their craft" by their master. But modern development has not tended in that direction, and at the present time, instead of a manufacturer deputing his teaching duties to persons paid directly by himself to perform them on his behalf, he delegates them to the nation generally. And the nation, recognizing the fact that the apprenticeship system is dead, accepts the responsibility, passes Technical Instruction Acts, and builds technical schools in which people can learn at a small fee how to use their brains and their hands for the benefit of themselves, for the benefit of the masters, and for the benefit of the nation at large.

Not only have technical schools come into existence in consequence of the universality of the division of labor in our day, but they are maintained to counteract the evils that arise from this very division of labor; and the remedy they apply is to give the apprentice a far wider knowledge of his trade than he can obtain from the highly specialized work at which he is kept in the factory. And so it is hoped that should the workman have his particular division of the trade taken away from him by the

general introduction of some machine, he may be able to avoid loss of work by turning to some other branch more or less allied to his own.

Great hitherto has been the diversity of opinion as to what should be taught at a technical school. Some advocate that the teaching in chemistry, for example, should be limited to a sound training in chemical principles and methods, while others urge that a technical school should be expected to teach the actual application of science to industrial processes. A third party, on the other hand, consider it proved that a technical school may with advantage aim at imparting a knowledge of what a few years ago would have been slightingly called mere handicraft.

Personally, I see no objection to instruction in any use of the hand being given at a technical school provided that it be accompanied with teaching that leads the worker to use his brain also; or, perhaps, I should say that since the teaching of any use of the hand cannot be adequately given without its being accompanied with a certain amount of mental training, such teaching has a perfect right to be regarded as a part of technical education. I am aware that a sharp distinction between education and training has been drawn by some authorities, and that they have pronounced it a misnomer to apply the name education to what is often called the training of the hand and eye. This appears to me, however, to be a mistake, for there is no radical difference in the method of trial and error which has to be followed in learning to perform any useful operation really well, whether it be making a first-rate fit between two pieces of material, skilfully fingering the violin, or adroitly solving problems in Euclid. Determination, application, the appreciation of the importance of accuracy and continued practice are necessary in each case, and the bodily as well as the mental improvement which is effected in the individual during the acquisition of any such form of dexterity is of the nature of education, but does not by itself, of course, constitute an entire education. When the dexterity has been once acquired, however, the mere repeated use of it is neither education nor training, any more than the daily solution of problems in trigonometry would be an education after a lad had mastered the methods.

So far from there being a risk of the instruction in a technical school becoming too practical, there is a much greater risk of its becoming too purely theoretical. For when a technical teacher has to spend the greater part of his time giving out information, he has but little left to take any in, and he thereby runs the risk of losing touch with his trade, or profession, especially if it be one in a state of rapid development, like electrical engineering. His so-called practical teaching may then easily become unpractical and untechnical, academic, stereotyped, and only distantly related to industry.

I would urge on my teaching brethren that not only should we keep in close touch with the trades we represent, not only should our aim be to avoid imparting antiquated, or unpractical, knowledge, but we should make an effort to keep our teaching to some extent even in advance of the industry it deals with.

There is, however, one subject of overwhelming importance which it is incumbent on every technical school to teach, especially as it is one that has been much neglected in the past, and that is the knowledge that the wide employment of machinery in a country is a real gain to every one of its inhabitants. Whether one reads in Charlotte Brontë's "Shirley" what was the feeling concerning the use of machinery at the beginning of the century, or in to-day's newspapers what is the attitude of certain workmen towards machinery now at the end of the century, one is struck at finding the same stubborn resistance fostered by the some misguided notion that the amount of work to be done in the world is a fixed quantity, and, therefore, that it ought to be dealt with sparingly and parcelled out like food among a shipwrecked crew, so as to be made to go as far as possible.

Speaking about the benefits to be derived from machinery, Prof. Ayrton said: Which, for example, is the country where the earnings of the workmen are the largest? Why, the United States—the one in which the use of machinery is the most extensive, where the highest wage goes with the smallest bill for labor in employments like the manufacture of steel, which, although developed in this country, is, partly for this reason, being rapidly wrested from us by America. The American preference for doing purely mechanical work with inanimate machinery, and reserving the animate instrument—man—for brain work, combined with the wide diffusion of technical knowledge on the other side of the Atlantic, has already inaugurated a keen rivalry with Great Britain. And this rivalry—which extends not only to foreign markets, where perhaps we could only hope to be on an equal footing, but even in the supply of goods to our own colonies and dependencies, where we might have expected to have an advantage—will grow into a supremacy unless we keep on our guard, and give unmistakable evidence of our readiness to adapt ourselves to new methods of manufacture.

But I hear some of you saying, this is political economy, or, at any rate, the economics of industry and not technical education, and that it would be unsuitable to offer such considerations to students who come here to learn watchmaking, weaving and woodworking.

Well, a good deal of sound political economy may be taught in connection with watchmaking. It might, for example, be impressed on the student that while the idea of using machinery in watchmaking was started in England, it was in America that it was first carried into practice, and it was Americans who first made large fortunes with machine-made watches. Meanwhile, the English watch industry steadily declined, until your townsman, Rotherham, revived it by introducing American watchmaking machinery in the face of the opposition of his workpeople, the loss of money, and apparently great loss of time. Now Mr. Rotherham employs automatic machines, constructed in his own engineering shop, with which he can turn out 500 high class watches per week, and so his name is known in many other places besides Coventry.

A most important part of all technical education consists not merely in encouraging people to learn how things are done today, but in leading them to ascertain what exactly is the particular result each special manufacturing process is used to accomplish, and then to consider whether the very same result cannot be arrived at more simply and more cheaply in some totally different way. For analysis and synthesis—the splitting up into elementary components and the building up again—is the basis of much invention, as it should be of all technical education.

It will be seen that one of the most important duties of a manufacturer is to create wants on the part of the public, and not merely to supply existing demands.

But there seems to be a considerable difference in the importance attached to the performance of this duty by the American and the English manufacturer. The American believes in the proverb, "L'Appétit vient en mangeant"—appetite comes with eating—and so he manufactures and supplies "notions" before the public is aware it is in need of them, whereas the Englishman, with some brilliant exceptions, does not take up a novelty until it ceases to be one, and until he is no longer able to resist the clamour of a public hungering after some innovation of recognized utility.

Contrast, for example, the overhead railways in New York and Chicago with the underground railway in London. The first were always airy (I have traveled on both), the latter always sulphurous, as I know to my cost. Yet, while the steam locomotive on the overhead American lines has given way to the electric motor, the use of electric traction on the London underground system—which is really a far more pressing necessity—is even now only under consideration.

The substitution of electric for horse traction in streets, which has excited so much interest in the world generally during the past few years, and which is just beginning to attract general attention even in our own country, differs from the bicycle trade and the electric light industry in that while giving work to many it must at first interfere with the employment of some, such, for example, as stablemen, dealers in horse fodder, harness-makers, etc. Ultimately, however, the total number of people who will be employed in connection with tramways will certainly be largely increased by the application of technical knowledge in the development of electric traction, for at the present time there are over 17,000 miles of electric tram lines in the streets of the United States on which run some 50,000 tram cars propelled with electric motors. Indeed, in Boston, which has a population only about one-tenth of that of London, the steam engines in the various stations which drive the dynamo machines for supplying electric current to the tramways can develop nearly 50,000 horse power continuously if required, and this, bear in mind, is altogether apart from, and in addition to, the engines driving dynamos for the electric lighting of that city.

The moral then seems to be for the methods taught at a technical school to be kept well up-to-date, and for you, its students, to do your best to excel in them, ever striving the while to increase your stock of those all-important characteristics—alert-

ness, thoroughness and truthfulness—not merely truthfulness in word, but also in work at the bench, the forge, and the vice, the truthfulness which is the slayer of shoddyism.

LETTERS TO THE EDITOR

The Review of Mr. Wiener's Book.

HAVING read Mr. Wiener's recent book, also Mr. Thorburn Reid's virulent review of the same in The Electrical Engineer of March 3, I feel that as a matter of common justice, both to Mr. Wiener and his publishers, and to the public, the latter should not be allowed to go unchallenged; for this excellent advertisement "next to pure reading matter" Mr. Reid has offered to the public "with an assumption of authority likely to give to those not conversant with the subject the idea that he is master of it," urged on by a sense of duty which would not allow him to forego an opportunity to glorify himself at the expense of the reputation of both Mr. Wiener and his book, and in a style suggestive of a country editor referring to an "esteemed contemporary."

Taking up these strictures in their order, the writer believes that they are poorly grounded and come from a hasty, if not malicious, inspection of the book.

Very few titles are comprehensive, and Mr. Reid can hardly expect one to form a compendious synopsis of the contents. Referring to page 34, first paragraph, the writer would like to have Mr. Reid explain how the diameter of an armature, whether smooth or toothed, can be increased without increasing the area of the air gap, the polar arc remaining constant, or without increasing the circumference.

While the method may be empirical, the writer believes that it is also practical, being based upon results obtained in actual practice, and if the tables are not correct, Mr. Reid cannot expect his allegations to that effect to stand without being more specific and offering proof.

As to the table on page 52, the writer believes that "the best modern practice" in this regard is purely a matter of conforming with required conditions of speed and output per unit of weight, it being the practice of the company with which the writer is connected to build machines of any size to run at any required speed. Attention is also called to the fact that this table is qualified by the paragraph preceding it.

A superficial inspection of table 6 and the paragraph preceding it (which Mr. Reid refers to further on) at once gives the impression that Mr. Reid's criticism is justifiable, and it is only by a thorough perusal of the book that this subject matter becomes understood, for we then find that this matter applies to intensity per square inch of air gap and is based on considerations of magnetic leakage.

The law stated in the fourth paragraph on the first page of chapter 3 is, without question, correct, for from a consideration of the fundamental law at the top of the same page, it is evident that a foot of inductor moving at the rate of one foot per second will cross one square foot per second, or 144 square inches, and as it is assumed that there is one line of force per square inch, this gives 144 lines, and there will be generated 144x11-8 volts, which is in no way a contradiction of the well-known fact that the cutting of a given number of lines generates a certain voltage, irrespective of the length of conductor, but in this case the length of conductor is given to simply serve as one factor to determine the number of lines of force.

Page 35, second paragraph, refers to an expedient with which Mr. Reid is, apparently, unfamiliar; for, given an armature supplied with a commutator with twice as many bars as there are coils in armature, and half the bars would be dead, while by cross connecting them to active bars, and supplying additional brushes, the effective brush surface will be the same as would be obtained by doubling the length of the commutator.

As to the effect that commutation has upon the magneto-motive force, it is very slight in any case, and as to the statement at the bottom of page 30, a study of Ewing's magnetization curves show that when iron has responded to an increase of magneto-motive force, a reduction of this force to its original value is not followed by a corresponding response by the iron, owing to the residual magnetism, or the "magnetic memory" of the material.

If the work in question is so replete with errors and erroneous statements as claimed by Mr. Reid, it is unfortunate that his random selections did not chance upon those which would bear a closer scrutiny. H. R. WELLMAN.

North Tonawanda, N. Y., March 16, 1898.

The Blumenberg "Carbon-Consuming Cell."

IN the description of the Blumenberg carbon-consuming cell, appearing in The Electrical Engineer of March 3, the claim is made that superheated steam supplies indirectly, by the alternate formation and decomposition of metallic oxides, the oxygen which combines with the carbon to form either carbon monoxide or carbon dioxide.

I wish to call attention to the fact that the oxidation of carbon to either the monoxide or the dioxide by such a process could not evolve energy, no matter what metallic oxides may be employed or whether they are entirely or only partly reduced during the process. Whatever metallic oxide may be employed as the transforming agent, the total energy resulting from the two reactions of decomposing water and subsequently oxidizing carbon would be the same as though the carbon acted directly on the steam. On the assumption that CO_2 is formed the sum of the reactions would be

$$C + 2H_2O = CO_2 + 4H.$$

Assuming that the water is introduced in the form of steam, the reaction would absorb over 20,000 calories, equivalent to a counter-electromotive force opposing the reaction of 0.21 volt.

On the assumption that CO is formed, instead of CO_2, the sum of the reactions would be

$$C + H_2O = CO + 2H.$$

This reaction would absorb 30,000 calories, equivalent to a counter-electromotive force of 0.64 volt.

If any electrical energy is evolved from a cell having the above reactions as the final result, it must be derived from the heat of the furnace, that is, it must be thermo-electric. But such reactions would not be possible under the conditions stated without the simultaneous formation of hydrocarbons, which Mr. Blumenberg does not mention. What becomes of the hydrogen left from the decomposition of the water? It cannot escape without carrying with it at least enough carbon to form CH_4, unless he claims to liberate free hydrogen. The energy lost in the escape of hydrocarbons will bear looking into.

The statement that natural ores could be used as "oxygen-bearing compounds" to develop electrical energy from carbon and simultaneously reduce the metal from the ore can apply only to the oxides of copper, as that is the only common metal whose oxide exists in nature as an "ore," which carbon has sufficient energy to reduce without absorbing external energy. The statement would apply to the oxides of mercury and a number of rare metals, such as thallium, silver, gold, platinum, palladium and iridium, but these oxides have not yet been found in nature as ores. CHARLES J. REED.

Philadelphia, Pa.

Traction Competition in Sweden.

Mr. R. W. Pope, Secretary of the American Institute of Electrical Engineers, received a communication the other day from the Vice Consul of Sweden and Norway at Washington, saying that the Royal Administration of the Swedish State Railways invites civil engineers or other interested parties to a competition of designs for the arrangement of new railroad stations, junctions, etc., etc., for the city of Stockholm. The first prize is to be 12,000 Swedish crowns (about $3,230); the second, 8,000 Swedish crowns (about $2,150), and the third, 4,000 Swedish crowns (about $1,075). The time for competition will expire at noon on the 31st of August, 1898. Particulars concerning the nature of the work will be furnished by the Swedish-Norwegian Legation, 2011 Q street, Washington, D. C., or by the Vice Consul of Sweden and Norway, Mr. August Peterson, Le Droit Building, corner F and Eighth streets, Washington, D. C. Security to the amount of $13.50 for the use of the drawings in this competition is required, but this will be refunded when the drawings are returned.

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The Inauguration of The Electrical Engineer Institute of Correspondence Instruction—Broadening the Bases of Electrical Education.

IN all times and in all ages it is learning and education which have distinguished man from his fellow man more than any other attribute. The things that make for education have therefore, with few exceptions, been fostered by the liberality of States or by private individuals, with results that have added immeasurably to the happiness and wealth of the world. What perhaps most distinguishes ancient and medieval educational efforts from those of modern times is the fact that the former were from the very nature of the conditions then existing confined to a small minority of the population, whereas to-day education is "popular" and is carried to its farthest limit.

Taking our own country, for example, its large number of universities, colleges and schools, both State and private, furnish admirable facilities for the acquisition of an education in all branches of the sciences and arts, and are accomplishing notable results, attested beyond doubt by the enormous development of knowledge and industry throughout the United States. Yet, notwithstanding the existence of so many educational institutions, the fact remains that many thousands, even hundreds of thousands of men and women, who desire more light, are by circumstances of one kind or another debarred from availing themselves of such institutions. That this condition of affairs is recognized and that attempts have been made to meet it, is evidenced by the so-called "university extensions." These auxiliary schools are doing admirable work and their influence is constantly aiding the diffusion of knowledge. But their scope is, perforce, limited, especially in the technical branches, and the methods of imparting knowledge pursued are not adapted to serve the wants of the great bulk of the population lacking the preliminary training necessary. How to meet the demand of the masses and more particularly of the toilers in the workshop and factory who want to lift themselves to higher spheres of usefulness than those of mere tenders of machines, has become one of the social problems of the day. Debarred from the advantages of an education which the technical schools afford, many a worker in the shop has hitherto sought in vain for a substitute. This is particularly true of the rank and file in the electrical arts which have sprung up like magic in the past twenty years. Moreover, besides the workers at the lathe and bench or engine, there are many occupying responsible positions as foremen, overseers and superintendents whose previous training took no account of the then unfamiliar electric arts, but who to-day see themselves confronted on every hand by the applications of electricity to the various industries with which they are connected. Then, again, the majority of experienced engineers, if of more than ten years' standing, graduates of schools of mechanical, mining, civil, hydraulic and other technical branches, often feel their impotency in dealing with the electrical questions constantly forced upon them; and they have striven to find a way out of the difficulties besetting them from their lack of information.

That this condition of affairs exists we know well from the letters received by the hundred from persons in every walk of life—from the workman, engine driver and dynamo tender to the practicing engineer. Our chief resource in the past has been to refer these anxious and earnest inquirers to the books best suited to their requirements. Of books on electrical subjects, there is no lack, it is true, but for the purposes of the classes of readers above referred to, books, as a rule, contain either too much or too little—much that is too advanced for the untrained student and mechanic, and too little for the engineer trained in other branches. What constitutes the greatest drawback to a book in the hands of the unassisted beginner is, that it answers no questions. Besides, even the newest electrical book is rarely up to date. The pressing nature of many of the communications above referred to has for a long time past impressed upon us the desirability of devising some plan by which the exact requirements of each individual could be met. It became evident from the start that a plan of this nature must possess two indispensable features. In the first place, it must involve but a small expense to the student; and in the second place, the system of instruction must permit of the student asking as many questions and receiving as many answers thereto as he may require to make clear every point as he goes along. While investigating methods best adapted for carrying out these ideas, the Toussaint-Langenscheidt system of language teaching now in extensive vogue abroad suggested itself; and it is based upon this system that The Electrical Engineer has established as an entirely separate and distinct enterprise The Electrical Engineer Institute of Correspondence Instruction. The aims of this Institute are to enable any one desirous of obtaining a thorough knowledge of the electric and allied arts to acquire it through the instrumentality of carefully prepared, printed lessons, supplemented by a system of confidential correspondence carried on between the student and the Institute, in which the student is at liberty to ask as many questions as he likes until he is satisfied that he thoroughly grasps every point in the lesson he is studying.

The advantages of such a system must be obvious. It constitutes each student a class by himself, leaving him entirely unhampered, as he would not be in a class of students, by dull or quicker associates; while on the other hand it guards against his being hurried through a course to keep up with a scheduled term. Each student can thus take his own time, and this permits him to study at such periods as he finds most convenient in the daily routine. Only he and his teacher need know that he is studying.

Without entering more deeply in the plan adopted, which is set forth elsewhere in this issue and is detailed in a pamphlet, to be had on application, we believe that The Electrical Engineer Institute of Correspondence Instruction will help solve the problem of affording to those desiring it the means of obtaining an adequate practical education in any of the branches of applied electricity. It goes without saying that The Electrical Engineer Institute of Correspondence Instruction is not in any sense intended to be a competitor with, or a substitute for, the estab-

lished schools of electrical engineering. Our advice to those whose time and income permit of it, is to attend such schools by all means. The Correspondence Institute, however, is the next best thing which we can recommend for the seeker after electrical knowledge. If the man cannot go to the university, the university can come to him.

In launching this new enterprise, we are fully alive to the responsibilities involved, and have made every proper arrangement to deal with them. We desire here to state that the Institute is a distinct corporation, operating under our auspices, its good faith and trustworthiness guaranteed by the standing of this journal. It is under separate management, has separate offices, and will be carried on without any relation whatever to the work and policy of The Electrical Engineer as a technical publication. We are deeply interested in its success, and shall do all we can personally to promote its welfare, believing that this is but one more way of raising the standard of electrical work and of advancing the electrical arts in the development of which we have long taken an active share.

A word as to the management of the Institute of Correspondence Instruction. The direction has been placed in charge of Mr. Herman A. Strauss, E. E. This gentleman has had a thorough electrical and mechanical training, acquired in this country and abroad, and brings also to his work a practical experience in teaching which cannot fail to inure to the greatest benefit of those who may entrust their electrical education to the Correspondence Institute.

A Matter of Station History.

IT has been said that the authoritative history of great national events cannot be written less than a hundred years after their occurrence, that is, after all the evidence is in. The historian who attempts to record and to discuss causes and consequences immediately after the event, be he ever so conscientious, may lack some sources of information and thus unwittingly leave himself open to criticism. What is true of national affairs is equally applicable to those that mark the progress of an art, and the electric arts in particular have been prolific in instances in which a revision of statement has been called for. It is hardly to be expected that the journalist in his record of contemporaneous progress can have access to all the data. In fact, part of his usefulness lies in eliciting it by controversy. It is thus that we find ourselves at the present time, with some correspondence before us from two very well-known men, each with claims to prior consideration. The "apple of discord" appears to have been a remark contained in the article descriptive of the new work of the Brooklyn Edison Company, in our issue of January 6. That article stated that "the credit of pioneering this movement in actual practice is due to the Brooklyn Edison Illuminating Company." Our readers will recall that the movement referred to was the adoption, in Brooklyn, of the high tension three-phase current for transmission and its conversion for every required purpose for local distribution, including direct three-wire, alternating and series arc lighting. The claimant to priority for this system is Mr. L. A. Ferguson, electrical engineer of the Chicago Edison Company, for whom it is contended that the suggestion of the use of this system of transmission and distribution was originally made by him to Mr. Barstow of the Brooklyn Edison Company as early as the spring of 1896; also that in a report to his company dated February 15, 1896, he advocated the adoption of such a system for the Chicago Edison Company, which ordered the apparatus in May, 1896. Mr. Ferguson also furnishes data as to the fact that he was the first to suggest to the engineering department of the General Electric Company, at Schenectady, the methods leading up to the development of this class of apparatus for use in connection with the Edison three-wire system. Additional testimony to like effect is cited in the remarks made by Mr. W. L. R. Emmet of the General Electric Company in a paper read before the National Electric Light Association in May, 1896. Mr. Emmet, however, withheld the name of the company (the Chicago Edison Company) that contemplated installing the system referred to.

In reply to the exceptions taken, Mr. Barstow of the Brooklyn Edison Company concedes that the idea of generating two kinds of current, direct and alternating, from the same generator, using the direct current for the immediate system and the alternating for transmission through rotary transformers to outlying territory, is due to Mr. Ferguson. Mr. Barstow points out, however, that when he entered upon the work of reorganizing the Brooklyn Edison Company's system in 1895 he found that in Europe there existed a multiphase system using rotary transformers, and with this as a preliminary starting point he began to work out the present Brooklyn system. But while such a system was easily applicable to the Edison low tension business, as in the case of Chicago, there had been, so far as he knew, no transforming devices developed whereby the multiphase system could be transformed into high tension continuous current for series arc lighting, except rectifiers, or whereby it could be transformed into alternating current of different phase and frequency. Without entering into greater detail, we may state that Mr. Barstow holds to the correctness of the statement appearing in The Engineer of January 6 that the Brooklyn Edison Company was the first to use in practice a three-phase system of transmission which is converted into any desired system of distribution, such as Edison 115 direct current, 500-volt railway current, 6,000-volt continuous current for series work, and two-phase 60-cycle current for local distribution. The fact that the production of alternating and direct current from one generator proposed by Mr. Ferguson, and employed in Chicago, is not in use in Brooklyn, Mr. Barstow believes, ought to relieve him from the responsibility of appropriating to himself the credit due Mr. Ferguson for that system.

With this evidence before them we leave it to our readers to form their own judgment on this rather interesting friendly controversy.

The Haines Vacuum Tube Lighting System.

THE New York World, in its issue of Sunday, March 20, describes the methods employed by Mr. John H. J. Haines in the production of light by means of vacuum tubes. Mr. Haines produces high frequency currents by means of a coil and double spark gap. It is claimed that with the wattmeter showing 200 watts energy consumption in the circuit, 16 tubes 5½ feet long and 2½ inches in diameter were lighted to full brilliancy. Mr. Haines is quoted as stating that he could equip an ordinary three-story house with his system for $200. This would give four tubes to each room, the power coming from the street circuit.

SAVED BY TELEPHONE.—A well known gentleman in this city, received last week a letter from his son, addressed to his daughter-in-law, in which the writer said he was in Washington in great suffering, and intended to take poison. Friends in Washington were immediately called up over the long distance telephone, and the young man was found by them at his hotel writhing in the agonies of poisoning. He was soon put in the hands of doctors, and his life was saved.

KLONDIKE. The electrically operated cable road over the Chilkoot Pass, driven by Westinghouse motors, is reported open, with a capacity of handling 150 tons of freight daily.

MISCELLANEOUS

Magnet Winding Curves.

BY J. P. STONE.

BY the use of the accompanying curves the calculation of the space required for the winding on magnet spools is greatly facilitated. These curves apply not only to magnet spools, but to any spools that are wound with wire. The diameter of wire can be easily found from the following formula:

$$\sqrt{\frac{A.\ T. \times L.}{V}}$$

This will give the diameter of bare wire in mils (or thousands of an inch). When A. T. = ampere turns per spool, L = mean length of one turn in inches, V = volts across one spool.

The number of turns and size of wire being known, the space required for the winding is found by dividing the total number of turns by the number of turns per square inch, as taken from the curves, for either single, double, or triple covered magnet wire.

In winding coils, unless the wire is put on in absolutely even layers with an equal number of turns per layer (which is possible only when using large wire and taking great care in winding), after a few layers are put on, the wire will be found to be somewhat uneven, and it becomes necessary to put in a strip of paper to even it up. The difficulty in winding wire accurately increases rapidly in small sizes, and this gives rise to waste space.

In calculating these curves, allowances have been made for imperfect winding (varying with the different sizes of wire), that have been found to give good practical results. There is a slight difference in the thickness of insulation used by different wire manufacturers, but this is not sufficient to lead to any trouble. The curves were figured for an average of all the principal makes.

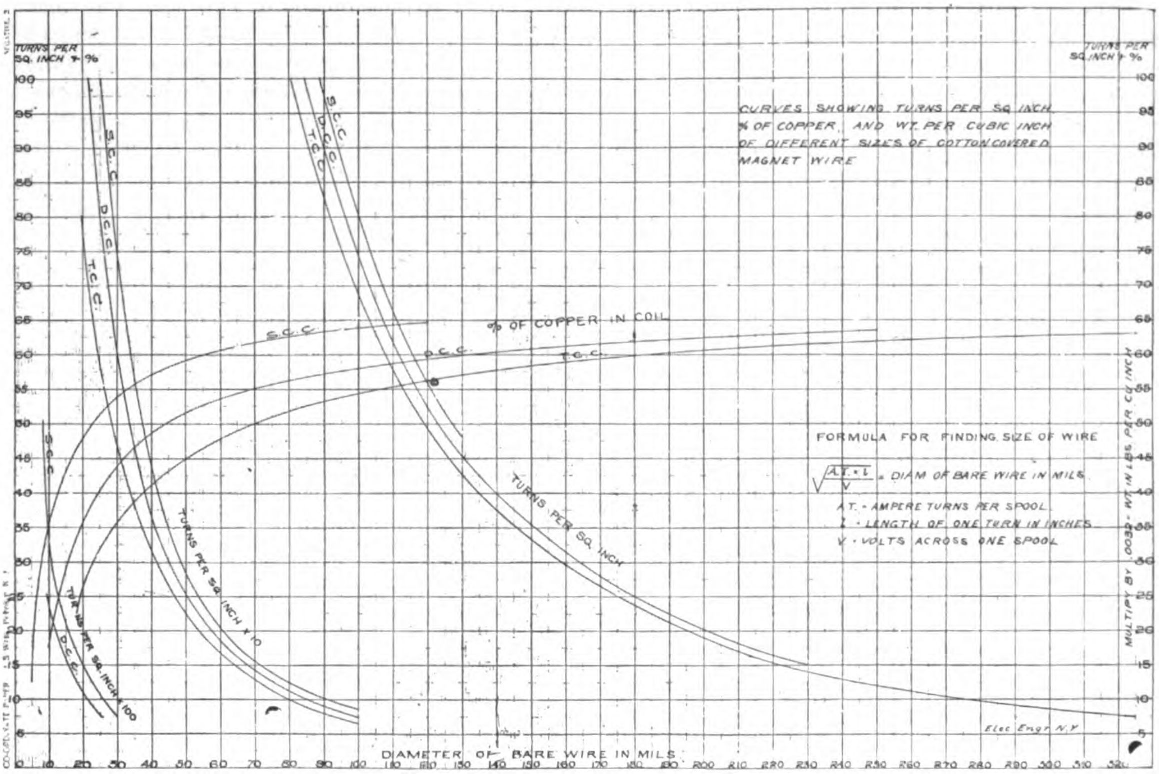
In order to plot the curves on a reasonable sized sheet the curves showing turns per square inch have been repeated twice, and the turns per square inch taken from the column on the edge of the diagram should be multiplied by 10 and 100 respectively.

Curves are also given showing the percentage of copper, that is, the percentage of copper in the total space occupied by the wire. The weight of wire can be found by multiplying the per cent. of copper taken from the curves by .0032. This will give the weight in pounds per cubic inch, the number of cubic inches being the area of the winding space on spool, multiplied by the mean length of turn.

Single covered wire larger than No. 8 or No. 10, B. & S. gauge, or about .120 inches diameter, is seldom used, and larger than No. 3 and No. 4, B. & S. gauge, or about .2 inches diameter, is usually triple covered, as this heavy wire is very stiff, and in winding it the insulation is easily broken.

Triple covered wire is not used in small wire, as the insulation is less likely to get damaged in winding, and also on small wire the insulation takes up such a large percentage of the total space occupied, that it is uneconomical to use a heavily insulated wire, unless occasion requires, this is easily seen by glancing at the curves of percentage of copper.

Hence, triple covered wire smaller than No. 22, B. & S. gauge, .025 inches diameter, and below No. 30, B. & S., or, .01 inch diameter, double covered wire is seldom used, as for these small sizes single cotton covered wire is generally sufficient. On small wire silk is used as a covering, as it occupies less space, but for most work cotton covered wire is preferred on account of its smaller cost.



CURVES SHOWING TURNS PER SQUARE INCH, PER CENT. OF COPPER, AND WEIGHT PER CUBIC INCH OF DIFFERENT SIZES OF COTTON-COVERED MAGNET WIRE.

Annual Report of the U. S. Patent Office.

The annual report of the Commissioner of Patents for the calendar year 1897 has been laid before Congress. It shows that in 1897 there were received 45,661 applications. Patents granted amounted to 23,729. The number of patents that expired was 12,926. The total expenditure was $1,122,843; the receipts over expenditure were $252,798.

In proportion to population more patents were issued to citizens of Connecticut than to those of any other State—one to every 786 inhabitants. Next in order are Massachusetts, District of Columbia, New Jersey, Rhode Island and New York. To residents of England 706 patents were issued; to residents of Germany, 551; Canada, 286; and France, 222.

The number of applications received for examination in the

year was greater than for any other in the history of the office, yet the report says there was no increase in the facilities of force for doing the work. Applications awaiting action on December 28 last numbered 11,382, due to the inadequacy of the office force.

Since 1882, 155 examiners and assistant examiners have resigned voluntarily from the office. The places left vacant by these men cannot be filled at once, and their resignation is a serious loss to the Government. An increase in salaries would hold a fair proportion of them.

A New Standard of Self-Induction.

A standard of self-induction, which can be theoretically computed with extreme accuracy has been constructed by I. Fröhlich. He cut a ring of Carrara, marble into a rectangular section, and wound it with a single spiral layer of insulated copper wire of radius 0.11147 mm. in 2,738 turns. The marble ring was 35 cm. broad and 20 cm. thick, and weighed over 100 kilogrammes. Its magnetic moment was, however, only 0.45. The advantage of using a single layer of fine wire was that no error was introduced by pressure of outer layers, and the correction for thickness of wire was only one-thousandth of the total coefficient, the latter being approximately 0.1 by 10^9 cm.—(Fröhlich, Wied. Ann., No. 13, 1897.)

The Preparation of Copper Samples for Conductivity Tests.

BY DR. S. SHELDON, Polytechnic Inst., Brooklyn.

WHILE the electrical fraternity is interested with the subject of standardization of electrical apparatus I should like to call atention to the necessity of adopting a standard condition of softness for samples of copper whose conductivity is to be tested. Of coures, users of copper wire are interested in the conductivity of the wire in the condition in which it is furnished to them—not in the conductivity which might have been given to the wire, if it had been treated differently. While the copper losses in most electrical machinery are but a small percentage of the output, and while the temperature at which the machinery will operate is uncertain, owing to the uncertainty of the factors entering into the heat escape, still in many cases a reduction of the copper losses by a few per cent. is worth struggling after. The determination of the conductivity of wire used for such purposes is an easy matter. On the other hand the requirement of a definite conductivity, frequently found in specifications for construction work, where rubber covered or similar wire is to be employed, gives no opportunity for the verification of the fact that the requirements of the specifications have been complied with. It is impossible to determine the cross section of the wire and the value given by the manufacturer must be accepted. Again the tinning of the wire makes the resistance measurement valueless. These difficulties are met in some cases by the purchasers sending inspectors to the factories to determine the conductivity before the wire is covered. This is perhaps the best solution of the problem under the circumstances and, according to Abbott, is the practice in American aerial line construction. To electrolytic copper refiners and all buyers and sellers of bulk copper for electrical purposes, a standard method of treatment of test samples is of utmost importance. Cases have been known where copper, contracted for future delivery at a certain price, has been rejected at the time of delivery because of too low a conductivity, the ruling price at the time of delivery being less than at the time of making the contract.

The American Institute of Electrical Engineers has adopted as its standard of conductivity for copper the value given by Matthiessen for soft copper. This is contrary to the original advice of the Committee on a Standard Wiring Table and resulted from statements made in the discussion of the report that there were many degrees of hardness, implying that a soft condition was easily obtainable and could be reproduced. To ascertain whether this were true or not I had two students of last year's class at the Institute, Messrs. Alfred Muller and Herman Wallatt, investigate the influence of softness upon the conductivity. A sample of wire was passed several times through holes in a draw-plate in such a manner as to yield a very hard wire. This wire was cut up into separate lengths. The assumption was made that the resistivities of these lengths were equal. The lengths were then separately subjected to different annealing temperatures for a fixed interval of time, the sample, in one set of experiments, being placed in a vacuum, and, in another set, in hydrogen. The different temperatures were produced by sending different currents through the samples. The temperatures were calculated from current measurements and measurements of voltage between separate potential terminals on the samples, Kennelly's temperature co-efficient being assumed as correct. After treatment the conductivities of the samples were calculated from measurements of resistance, length, weight and specific gravity. The results obtained for samples annealed in a vacuum are given in the following table:

Number of Sample.	Annealing Temperature.	% Conductivity.
1	20°	101.5
2	37°	101.5
3	54°	101.5
4	118°	101.6
5	215°	102.0
6	300°	102.1
7	600°	102.4
8	755°	102.7
9	930°	99.0

The results for samples which were annealed in hydrogen are given in the following table:

Number of Sample.	Annealing Temperature.	% Conductivity.
10	20°	99.0
11	45°	99.0
12	105°	99.3
13	234°	99.8
14	360°	101.0
15	483°	101.9
16	1050°	89.3

One end of sample 16 melted after annealing current had been flowing for about a minute. A sufficiently long wire remained for the conductivity test. This sample was very soft and had lost much of its tensile strength.

These results show that annealing to a softness which shall give a maximum conductivity must take place at a high temperature regulated within rather narrow limits. The maximum mechanical softness would be obtained if the sample were melted and, after being cast in a graphite mould, were allowed to cool off slowly. Very smooth filiform samples can be obtained in this manner. But the conductivity of copper is so dependent on the amount of suboxide of copper which is present in it, and this amount is altered to such an extent by melting, that the conductivity determinations on such samples give no indications of the electrical properties of the original samples. As has been recently stated by Swan, the electrical conductivity of electrolytic copper is reduced by more than one per cent. by melting and casting into the form of wire bars. It would, therefore, appear to be better to subject all samples to the hard drawing process. Conductivity tests would then properly indicate the original electrical quality of the copper.

Municipal Electric Lighting.[1]—V.

BY PROF. JOHN R. COMMONS.

THE city of Watervliet has, for seven years, furnished its 115 arc lamps at a cost of $75 each, including depreciation, but not interest. Its neighbor, Troy, has paid a private company $146 for like service. Watervliet's plant cost $26,000, but was paid for in two assessments without the issue of bonds. Distributed over the entire period, this investment would have been equivalent to $31 per lamp year, making the total expense to the taxpayers $106, against the $146 paid by Troy. It is proper enough that interest should be omitted from the computation of Watervliet's annual expense, and, should a commercial system be added, the consumers should have the benefit of charges based on freedom from interest payments. Therefore, while criticizing Professor Parsons' reasons, I agree that both he and city officials are right in figuring interest only on the outstanding debt. This gives the true cost of production to the taxpayers, and the saving of interest in this way must be counted as one of the most important economies which municipal ownership brings. This saving, of course, does not appear

[1] Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec. Engr.

prominently in the early years of the enterprise, but it becomes increasingly valuable as fast as the debt is liquidated. Foster's computation of interest at six per cent. on the entire cost of plant to date is therefore doubly excessive, for, besides the falsely high rate, it includes interest on new construction paid out of profits and savings which are not properly considered an investment and entitled to interest payments.

EFFECT OF MUNICIPAL OWNERSHIP ON RATE OF TAXATION.

The amount of taxes paid by electric light companies varies so widely in different States and cities that it is impossible to state a rule that will have general application. Parsons says that the amount actually paid by the companies is about two dollars per arc equivalent or three-fourths of one per cent. to one per cent. on the fair investment. In New York City, according to the census report, it was one-third of one per cent. on the total valuation, or, omitting patents, six-tenths of one per cent. In the State at large it was one-half of one per cent.

According to the report of the Massachusetts Gas and Electric Light Commissioners the total amount of taxes paid by all the electric light companies of the State for the year ending June 30, 1896, was $168,218.83, which was four per cent. of their gross receipts ($4,187,260), six and two-tenths per cent. of their operating expenses ($2,739,783), and 1.06 per cent. of their total assets ($15,892,336). The two Boston companies with the equivalent of 22,970 arc lamps of 2,000 capacity each, installed for both street and commercial lighting and motors, paid in 1896 taxes amounting to $72,333.96, being $4.42 per arc equivalent, and 1.05 per cent. on the combined assets of the companies ($6,898,786).

The Edison Illuminating Company of New York, with the equivalent of 42,582 arcs, installed in 1895, paid for "general and legal expenses and taxes," $218,421, equal to $5.13 per arc, showing taxes to be much less than in Boston.

The Detroit assessors at the request of the Public Lighting Commission placed an assessed valuation on the city plant at $427,500, the amount of the investment for the year having been $714,843.76. Computing city taxes on this valuation, the loss to the city in taxes was $7,981.43, or $5.10 per arc light, or one and one-tenth per cent. on the cash investment.

The Massachusetts rate of taxation on corporations is unquestionably higher than that in any other State, and the rate of one per cent. on the total investment may, therefore, be taken as the maximum taxes which the city loses through municipal ownership. But it is a mistake to consider this as a loss to the taxpayers. It is more than compensated by the increased valuations of property which follow upon increased municipal lighting. In Jamestown the extension of lamps to the suburbs, and to unimproved property, has contributed largely to the building up of outlying areas and the consequent increase of assessed valuation. Where there is a commercial plant the reduction of twenty-five to fifty per cent. in commercial rates increases the profits of business and hence the valuation of real estate and business holdings. This tends to lessen the tax rate. Altogether, we are justified in omitting the item of lost taxes entirely as an element in the cost of municipal lighting, but for the sake of the broadest possible treatment of the subject I have estimated it in the computations made in this article at one per cent. on the total cost of the plant to date. Were it omitted, it would reduce the cost per lamp per year as herein computed from $2.00 to $5.00 each.

SHOULD MUNICIPAL PLANTS BE INSURED?

Insurance actually paid is usually entered in operating expenses and need not be added as a fixed charge. It is a small item, one-half of one per cent. in Batavia, nothing in Dunkirk, one per cent. in Watervliet, two-tenths of one per cent. in Jamestown, computed upon the total cost of the plant. The larger cities, Detroit and Chicago, do not carry insurance. This is proper enough for a large city where the loss by fire when spread over the tax rolls would cause but an insignificant increase in taxes, but small towns like Tipton, Iowa, whose plant was destroyed by fire, are unable to rebuild, especially if already in debt. In addition to carrying a small insurance, such towns should provide a sinking fund and depreciation fund which are in a way a sort of insurance.

RATE OF DEPRECIATION OF ELECTRIC PLANTS.

Depreciation is the item of keenest dispute in the contest over municipal electric lighting. Mr. Francisco quotes electrical engineers who assert that the depreciation on engines and boilers is 5 per cent., on electrical apparatus lamps and dynamos 10 per cent. He does not itemize any other parts of a plant, and taking these two the depreciation for the first year on the total cost of the Detroit plant would be 1.4 per cent. as follows, instead of 8 per cent. as usually estimated by him.

TABLE VI.

ESTIMATED DEPRECIATION ON DETROIT MUNICIPAL PLANT 1895-6.

	Cost	Rate per cent. of Depreciation	Amount of Depreciation
Steam plant	$82,152	5	$4,107
Arc lamps	29,628	10	2,962
Electric plant	40,842	10	4,084
Balance of entire plant	477,519	0	0
Net cost of plant to date	$630,141	1.4	$9,153

Professor Parsons arrives at his estimate of 3 per cent. depreciation in the following way, taking the Braintree plant as an example.

TABLE VII.

BRAINTREE-DISTRIBUTION OF INVESTMENT AND DEPRECIATION.

	Investment	Per cent. of Depreciation	Amount of Depreciation
Land	$940	0	$ 0
Buildings	6,630	1	66
Steam plant	11,900	4	476
Electric plant	7,640	3	229
Lines	13,580	1	136
Poles	3,630	10	363
Lamps	4,630	4	185
Meters	1,560	2	31
Transformers	2,280	3	68
Tools and furniture	580	8	46
Supplies	610	0	0
Services of architect and engineer	620	0	0
Total	$54,600	2.9	$1,600

For an underground plant like that of Chicago, he figures the depreciation at one and six-tenths per cent. of the total investment, as follows:

TABLE VIII.

CHICAGO-DISTRIBUTION OF INVESTMENT AND DEPRECIATION.

	Investment	Per cent. of Depreciation	Amount of Depreciation
Land	$100,000	0	$ 0
Buildings	66,987	1	669
Steam plant	95,518	4	3,820
Electric plant	58,075	3	1,742
Lines	317,040	1	3,170
Poles	....	..	....
Lamps	41,240	4	1,650
Tools and furniture	610	8	50
Supplies	8,840	0	0
Total	$688,310	1.6	$11,101

Water Power Transmission for Rochester, N. Y.

A BILL has been introduced in the New York State Legislature providing for the incorporation of the Genesee Power Company with a capital stock of $3,000,000, with power to increase to $12,000,000 in shares of $100. The men mentioned as incorporators and directors are: William A. Boland, of New York; Cassius M. Wicker, of the banking firm of Hollins & Company, representatives of the Baring Brothers, New York; Theodore W. Myers, banker, formerly controller of New York City; George H. Keller, capitalist, New York; George W. Rafter, engineer, Rochester.

This company proposes to revive the Genesee River storage dam project in a new form. Heretofore it has been advocated as a State work, but now private capital is about to take hold of and develop the scheme. It is understood that the water right owners and millers of Rochester are a unit in support of the bill, which provides for the building of a dam in the upper Genesee

River, near Portage, and the consequent sale of water and water power.

At a point about 1,400 feet above the Erie Railway bridge the Portage gorge presents very favorable conditions for the erection of a dam. Solid rock exists immediately in the bed of the river, with only a couple of feet of water flowing over it, and also extends high up on the bluffs on either side. Furthermore, the channel is much narrower than the most favorable location hitherto surveyed in the Mt. Morris Canyon, so much so that the actual amount of masonry required to construct a dam 118 feet in height is less than one-half the quantity required for a dam 130 feet in height as formerly proposed at Mt. Morris. This is so because the required depth of foundation is different and to the less length of dam. A dam 118 feet high at Portage would store 15,000,000,000 cubic feet of water as against a mean storage at Mt. Morris of 7,370,000,000. The width of the surface of the lake thus created would be from one to two miles, the widest point being at Rush Creek, in Allegheny County, where there is low land on each side of the river. This sheet of water would be as large as Canandaigua Lake, and have an average depth of 60 feet.

The cost of building the dam, as estimated, is as follows: Land damages for reservoir, $650,000; changing location of the Western New York & Pennsylvania road, $550,000; dam, $1,000,000; wagon road bridges over reservoir, $100,000; clearing reservoir, $30,000; wagon road around reservoir, $30,000; moving cemeteries, $15,000; contingencies, engineering and law expenses, $225,000.

One of the important points made in the bill providing for the incorporation of the company is that it requires the company to hold in store during each navigation season, subject to the requisition of the State Superintendent of Public Works, 2,500,000,000 cubic feet of water, the price per million feet to be subject to arrangement between the Superintendent of Public Works and the company. The company announces that it does not consider that furnishing water to the State will form any material part of its business, but it expects to materially increase the amount of power obtained from the river. One year when it was very dry the river for several months furnished only 5,500 horse power, while with a storage dam the minimum would be not less than 30,000 horse power.

It is also thought that very material sanitary results would be accomplished, not only by keeping clear the bed of the river from Main street to the upper falls, but also by increasing the flow of the lower river, now badly polluted by sewage.

Diagram for Determining the Power of Waterfalls.

MR. OLIN H. LANDRETH, of the Union College Engineering School, in a communication to "Engineering News," gives the following useful information regarding the determination of the power of waterfalls: I send you enclosed a copy of a diagram for the graphical determination of the horse power of any given waterfall, being a simple form for the graphical reading off of the horse power from the formula,

H. P. = H. Q. D. E. ÷ 500, in which:

H = The effective head on the wheel in feet.

Q = The quantity of water flowing in cubic feet per second.

D = Weight of water per cubic foot.

E = The percentage of efficiency of the wheel.

For D = 62.4 pounds per cubic foot; H. P. = 0.1134 H. Q. E.

The inclined lines radiating from the zero at the lower left corner are of three different kinds: Those running to the upper edge of the diagram represent the quantity of water; those running to the right side of the diagram represent the different percentages of efficiency, except the one line which crosses the margin between 85 per cent. and 90 per cent., which is a conversion line to transform the resulting value of the horse power into such linear values as to permit them to be represented by the graduations along the base of the diagram. This line is drawn at an angle with the vertical lines, whose tangent t = ½ (0.1134) 75.v/h, where v and h are the numerical values of the vertical scale of head and the horizontal scale of quantity; the ½ being introduced in this case to make the horse power units along the base of the diagram one-half the value of the quantity units along the top edge of the diagram. To use the diagram: Start with the value of the head on the left margin, pass horizontally to the radiating line representing the given quantity, thence pass vertically down to the proper efficiency line, thence pass horizontally to the inclined conversion line, thence vertically down to the horse power line along the base of the diagram, where the proper value may be read off. With heads or quantities in excess of the maximum value of the diagram, the scales may be assumed changed to ten times that graduated and the resulting horse power read off to a scale either ten or one hundred times

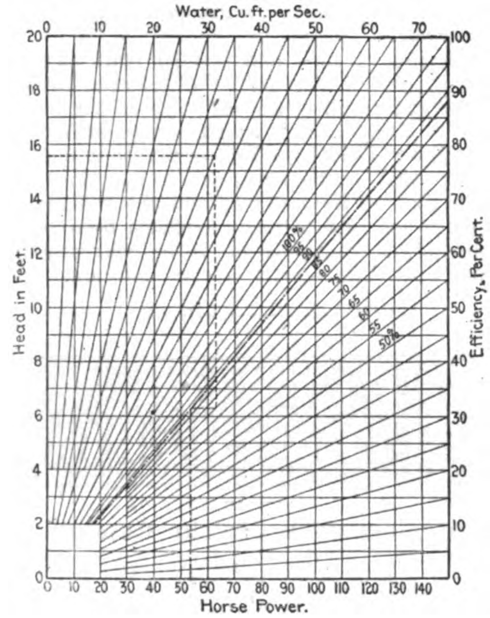


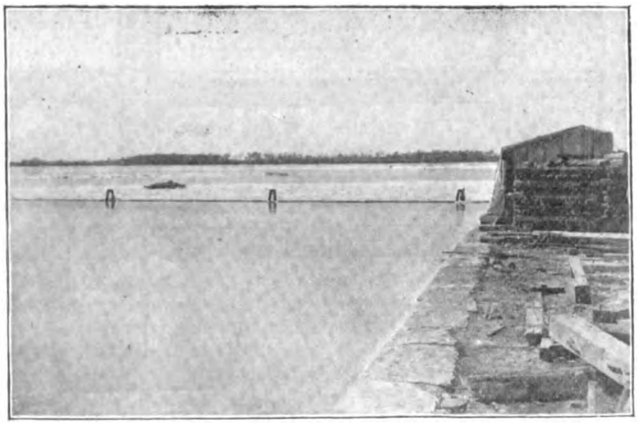
DIAGRAM FOR DETERMINING HORSE POWER OF WATER WHEELS AND WATERFALLS.

Example: Head = 15.6 feet. Quantity = 40 cubic feet per sec. Efficiency = 75%. Then horse power = 53.2.

that graduated, according to whether one or both the argument scales have been amplified. One or two other arrangements of the lines indicating respectively the heads, quantity and efficiency have been used but the one here given is offered where compactness is the prime requisite.

Preventing Ice and Drift From Entering the Niagara Canals.

WHEN the great ice fields break up in Lake Erie large quantities of it enter the Niagara River at Buffalo and pass down stream to the Falls. In order to prevent it or any other drift entering the canals both the Niagara Falls Power Company and the Niagara Falls Hydraulic Power and Manufacturing Company place booms at the entrance to their canals to protect them. In the case of the Niagara Falls Power Company



METHOD EMPLOYED AT NIAGARA FOR PREVENTING THE ICE FROM ENTERING THE CANALS.

pany the inlet canal is directed down stream at the river and the boom, which remains in place the year around, rests against iron piers firmly fastened to the rock bottom. It serves to effectively divert the ice in winter as well as large quantities of pulp wood which in summer is floated down stream inside a boom from Schlosser Dock to the Niagara Falls Paper Com-

pany's mill. The boom which protects the inlet canal is made of large timbers.

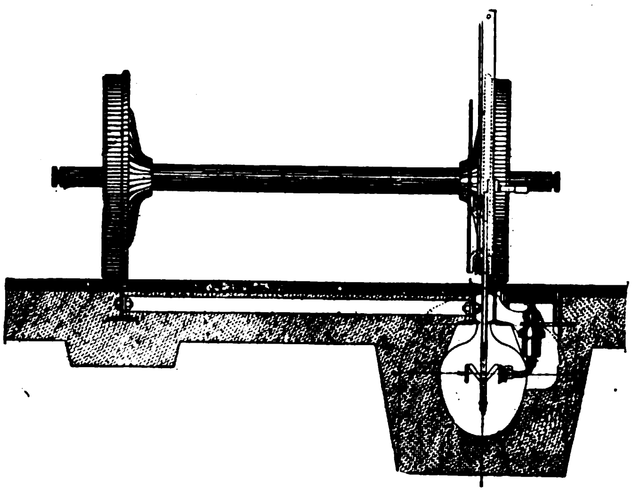
The Niagara Falls Hydraulic Power and Manufacturing Company do not leave their boom across the entrance to the canal the year around, but in summer fasten it to the canal wall close by. With the coming of winter it is placed in position across the entrance to the canal and proves a barrier to the ice entering the waterway.

It is interesting to note that just 50 years ago on the 29th of this month (March 29, 1848) the Niagara River is said to have run dry as a result of a great ice blockade at the entrance to the river at Buffalo. It is stated that so heavy was the field of ice coming out of old Lake Erie at that time that it gorged to such an extent that no water was able to pass down stream, thus allowing the Falls of Niagara to practically run dry. Never before nor since has such a weird spectacle been presented, and the Niagara power companies are to be congratulated that the flow of water to their wheels is ever constant.

ELECTRIC TRANSPORTATION

Improved Siemens & Halske Conduit Railway.

THE underground electric railway system of Siemens & Halske, which has been in use for many years at Budapest and on several short lines in Berlin, is a slotted conduit system, the conduit and conductors being located directly under one of the rails, as shown in the figure. Its latest form is shown in the accompanying cut, which makes an interesting comparison with the recent methods adopted in New York City. The line of one of the rails is identical with the opening of the conduit, and in this way there are only two channels in the street, similar to any ordinary track construction. The one rail is of the ordinary grooved type, laid on a bed of cement or gravel. The other rail rests on the top of the conduit and consists of two similar rails of special cross-section, which leave between them a slot of about 1¼ inches in width. The outer one of these two rails serves as a running rail for the wheel, the inner one as a guide rail. The slot takes care of the rim of the wheel. The double rail rests at convenient distances on cast-iron blocks. This gives the necessary elasticity to the upper construction and insures easy riding. The rails are secured to the blocks by



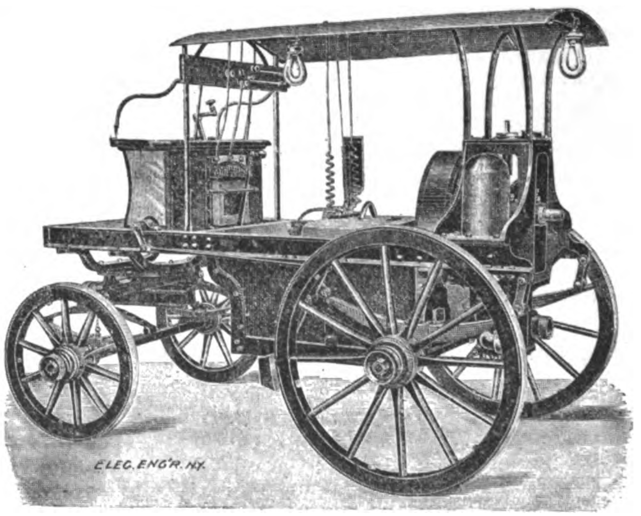
SIEMENS & HALSKE UNDERGROUND ELECTRIC RAILWAY; SECTION THROUGH CONDUIT.

means of angle irons, which are bolted to the foot of the rail. A narrowing of the slot is prevented by the foot of the rail resting against a cast extension on the block. The blocks which span the egg-shaped conduit with two arms serve as ribs of the canal, which is formed of cement built on a wooden foundation. The water entering the conduit through the slot is led into the sewer pipes through numerous outlets provided with means for keeping back all solid matter which might obstruct the passages. The T shaped conductor rails are located along the two sides of the conduit on heavy insulators in such a manner that they cannot be seen or touched from the top, and at such height above the bottom of the conduit that they are not touched by water in the conduits. The insulators are reached through cast iron boxes on the surface, so that they can be replaced with ease and rapidity.

The plow, which is of familiar form, consists of a highly insulated plate, which carries at its lower end two metallic tongues, and at its upper end connectors for connecting it with the motor circuits. The two metal tongues press firmly against the conductors in the conduit by means of springs, and in that way complete the circuit. When it is desired to take the plow out, these tongues close up and do not hinder the operation. In changing over from the underground to the overhead system a special device is brought into action, which cuts the plow in and out of circuit and connects the motor to the trolley without any appreciable loss of time.

A German Electrically Equipped Fire Engine.

THE fire engine illustrated herewith has just been placed on the market by the firm Carl Metz, of Heidelberg, Germany. The machine cannot on account of the weight of accumulators carry its own current generators or source of supply. However, a small battery of sufficient capacity to furnish power for conveying the engine to the place of fire could be carried; but this would make the engine heavy, complicated and expensive. The electric current is supplied from the outside. A modern plant should have its leads running through all the



METZ ELECTRICALLY EQUIPPED FIRE ENGINE.

principal streets and have outlets every few hundred yards. The current can then be delivered to the motor by means of flexible cables carried on the engine. The proper terminals and connecting posts are provided at the cable and outlets. It is proposed to adopt this system in the larger cities and attach the outlet boxes to the sides of buildings. The advantages of the electric motor are the simplicity of service and absolute safety, as long as a low tension current is used. The apparatus will probably be hailed with delight by factories having electrical plants where the fire engine might prove of good and efficient service.

Prizes Awarded by the "Académie des Sciences.'

Among the prizes awarded by the Académie des Sciences for the year 1897 are the following: The La Caze prize (physics) to Dr. Lenard for his work in connection with cathode rays, the Gaston Planté prize to M. André Blondel for his well-known research work in various directions, the La Caze prize (physiology) to Prof. Röntgen for his great discovery, and the Montyon prize (medicine and surgery) to MM. Rémy and Contremoulin, and MM. Marie and Ribaut for collections of X-ray photographs.

LITERATURE

THE PRINCIPLES OF ALTERNATE CURRENT WORKING. By Alfred Hay, B. Sc. London, 1898. Biggs & Co. 276 and iv. pp. 5 x 7 inches. Cloth. Price, $2.

The contents of this book embody the lectures delivered before a class of engineers, and hence the work throughout is kept down to a plane such that it is specially serviceable to those who are beginning to take up the subject of alternate current as applied to the design of dynamos, motors, transformers and the operation of alternate current circuits.

After stating and explaining the fundamental laws and principles, the author takes up the experimental determination of e. m. f. and current waves, special application to sine functions, practical measurements of power, etc. The effects of phase displacement are very clearly pointed out as well as those of capacity.

Special chapters are devoted to the principles underlying transformer design, synchronous motors and parallel running of alternators, and to polyphase motor work.

As an introductory to other more advanced treatises on the subject the book ought to prove highly beneficial to the student. Examples for applying the principles taught are given throughout the work, and brief historical notes and references appended to each chapter enable the reader to find more extended information on the topics treated of.

ANDERSON'S PHYSICAL EDUCATION. By Dr. W. G. Anderson, Professor of Gymnastics at Yale University. A. D. Dana, publisher, 853 Broadway, New York. Price, 25 cents.

The book treats of every phase of body building and is "up do date" in every particular. There are special chapters devoted to professional people, business men, women and children. It tells how to decrease your weight if corpulent and increase it if thin. It gives valuable measurement charts for both men and women. Every reader interested in better health, greater strength, grace, self-control, elegant carriage, should possess a copy of this work. We know of no work that gives so many useful and helpful suggestions in such compact and readable form. The illustrations, about one hundred in number, are taken from drawings and life.

BIBLIOGRAPHY OF X-RAY LITERATURE AND RESEARCH, 1896-1897. Edited by C. E. S. Philips, London, 1897. The Electrician Printing and Publishing Co., New York, D. Van Nostrand Co., 68 pp.; 5½ x 8½ inches. Cloth. Price, $1.50.

The title of this work explains its nature fully. The editor has evidently done his work very thoroughly and the short abstracts which accompany many of the references will be of material help to investigators and students. A short historical review accompanies the work, showing how various workers in the past contributed in one way or another to pave the way for Röntgen's great final discovery. The chapter devoted to practical hints in X-ray work, though short, is full of valuable hints. The frontispiece shows a group picture of the most prominent workers in the X-ray field. We can recommend the work very highly as a guide to the literature on the subject, the method of indexing being particularly well calculated to save time in the quest for work done in any particular department of the subject.

THE X-RAYS, THEIR PRODUCTION AND APPLICATION. By Frederick Strange Kolle, M. D. 250 pages, cloth, 50 illustrations, of which 12 are full-page, half-tone. New York: J. S. Ogilvie Pub. Co. Price, $1.

Dr. Kolle was one of the first medical practitioners in this country to take up Röntgen ray work, and has from the very start pursued his studies in that field with a great deal of energy and intelligence. He not only embodies X-ray data in this book, but furnishes a large amount of information as to the nature and use of electricity, going into a great many useful and interesting details on the subject. We believe that this book will be of great value, particularly to medical practitioners, photographers and serious amateurs.

TRASMISSIONI E DISTRIBUZIONI POLYFASI (Polyphase Transmission and Distribution). By Prof. Riccardo Arnò, Turin, 1897. Unione Tipigrafico-Editrice. 54 pp.; 5 x 8 inches. Paper cover. Price, $1.

This little work embraces the lessons of Prof. Arno, who succeeded Prof. Ferraris at the Electrotechnical Laboratory of the Royal Italian Industrial Museum, Turin. The author discusses briefly the various methods of polyphase distribution, describing the delta and Y connections, and special systems of distribution, such as those of Scott and the Steinmetz monocyclic system. Considerable space is also devoted to the Ferraris-Arno system of polyphase distribution and its various modifications.

SCIENCE ABSTRACTS. Vol. I., No. 1. Edited by J. Swinburne, London, 1898. Taylor & Francis. 50 pp.; 6 x 9 inches. Paper cover. Price, 36 shillings per annum.

This is the first number of a monthly publication issued under direction of the London Institution of Electrical Engineers and of the Physical Society of London. The plan adopted has been to divide the subject matter into departments under the following heads: General Physics; Light; Heat; Sound; Electricity; Electro-Chemistry and Chemical Physics; General Electrical Engineering; Dynamos, Power Distribution and Lighting; Telegraphy and Telephony. The abstracting has been very carefully done, Mr. Swinburne being assisted by no less than thirty-six abstractors. The value of a permanent record of this kind must be apparent, and we know that the efforts of the originators of this valuable aid to the technical reader will be appreciated by many busy workers.

MODEL ENGINES AND SMALL BOATS. By Nevil Monroe Hopkins. D. Van Nostrand Company, New York, 1898. Cloth. 74 pages. Price $1.25.

The mechanically and also nautically inclined youth will find in this interesting volume a mint of valuable information on the design and construction of small marine engines, of small steam cylinders without patterns and castings and boilers without the use of special tools. He will be enabled after a perusal of this book and aided by his mechanical ability to apply the methods here outlined in a general manner, embracing almost any type of model engine and boiler. A chapter on elementary boat design is given, followed by a system of hull construction, using wooden ribs in connection with cardboard plating. The book is written in a clear and fascinating style and is well and profusely illustrated. A similar book by the same author, dealing with the simple construction of electrical apparatus, would be welcomed as a valuable addition to electrical literature.

ROENTGEN RAYS

Radiography with its Recent Applications.[1]

BY PROF. ARTHUR W. GOODSPEED.

THE first step toward the X-ray tube was made many years ago by Geissler, who produced many curious and beautiful effects by exhausting the air from fantastically shaped glass tubes, and passing a high voltage current of electricity through the rarified gas within. A spark which can travel only nine or ten inches in the air, may in a Geissler tube, pass over a distance of thirty or forty feet. In the Geissler tube only about one-thousandth of the air is allowed to remain. Subsequently Crookes, of England, carried the exhaustion to a much higher degree than Geissler, allowing only about one-millionth of the original quantity of gas to remain in the tubes. On passing an electric discharge, the results were so different from anything ever observed before that Crookes felt impelled to speak of a

[1] Abstract of a paper read before the Electrical Section of the Franklin Institute.

gas in this state of rarefaction as the "fourth state of matter." It was while experimenting with Crookes tubes that Röntgen made his wonderful discovery.

The best authorities say that one cubic centimeter of air under standard conditions, contains 100,000,000,000,000,000,000,000 separate molecules flying around with inconceivable velocity in all directions, bumping against their neighbors and the inner surfaces of the containing vessel. By dividing this number by 1,000,000 we find that there are yet remaining in each cubic centimeter 100,000,000,000,000,000 molecules. This then represents the state of things within the tube where the X-rays are generated. Ordinarily the molecule of a gas can move only the smallest fractional part of an inch before striking its fellow molecule, but in the X-ray bulb, the mean free path of the molecule is several inches. When the discharge is sent through the tube, the molecules are projected with enormous velocity from the negative terminal, or cathode. The cathode is a spherical concave aluminum projector which directs the moving molecules against a small rectangular piece of platinum foil, placed at an angle of 45 degrees, in the centre of the tube. The molecular bombardment heats the platinum foil white hot, and if care is not exercised the foil may be melted, although it has a melting point very far above that of most other substances. It is here at the surface of the platinum that the X-rays are produced.

As to the nature of the X-rays, the consensus, at present, of the best opinions is that they are produced by transverse vibrations in the ether similar in nature to ordinary light, but of vibration frequency vastly greater.

According to Sir G. G. Stokes, in a paper read before the Manchester Literary and Philosophical Society last summer, "the Röntgen emanation consists of a vast succession of independent pulses, starting respectively from the points and at the times at which the individual charged molecules projected from the cathode impinge on the target. At first sight, it might appear as if mere pulses would be inadequate to account for the effects produced, seeing that in the case of light we have to deal with series consisting each of a very great number of consecutive undulations. But we must bear in mind how vast, according to our theoretical views, must be the number of molecules continued in the smallest quantity of ponderable matter of which we can take cognizance by our senses. Hence, small as is the quantity of matter projected in a given short time from the cathode, it may yet be sufficient to give rise to pulses, the number of which is inconceivably great."

The lecturer then showed a number of lantern slides illustrating the practical application of Röntgen ray photography.

News and Notes

A Use for Electric Light Carbon Ends.

At last a use has been found for the unburnt ends of carbon taken from electric arc lamps. Mr. Johnston, the foreman of the smiths' and wood-working shops of the Baldwin Locomotive Works, in Philadelphia, has recently instructed the man who changes these carbons in the lamps throughout the works to save the partly consumed pieces and bring them to him daily. He gets in this way some sixty or seventy carbon stumps which he utilizes for making a small charcoal fire of great heat and purity, suitable for any kind of special small work not interfered with by the copper coating on the outside of the carbons. Mr. Johnston having shown the way, others engaged in kindred lines of work ought to follow his example. It stands to reason that carbon prepared with so much pains to keep it pure and homogeneous, must be serviceable for some of the many uses for which charcoal is required. The copper coating might be an objection for some things, but if the collections of stumps were large enough, it might pay to remove the copper with nitric or sulphuric acid, thus getting an absolutely pure nitrate or sulphate of copper, for either of which there is always a practically unlimited demand in the arts.—Cassier's Magazine.

A Successful Failure.

A rather amusing incident took place several months ago in the yards of the Chicago Ship Building Co., which showed how a piece of electrical apparatus could be at once both a success and a failure.

The Chicago Ship Building Co., which has extensive yards for building lake vessels on the Calumet River at South Chicago, has, like all progressive concerns of the kind, introduced compressed air and electricity wherever possible in the process of ship construction. It has a power house in the centre of the yard where the dynamos and air compressors are located. One of the important uses of compressed air is for driving pneumatic hammers for deck calking on iron decks. In this process the hammer is fitted with a sharp tool which is made to follow the flush joint between the two plates and burr the corners over so as to make a water-tight joint. This was formerly done with a hand hammer and the workman held the tool in one hand and hammered with the other. When the pneumatic calker was first introduced the workmen saw in it one of those much to be shunned devices to enable one man to do the work formerly done by five or six, and they immediately discovered that it was impossible to follow a seam with a pneumatic calker and that the tool wandered all around the adjacent plate in a most unaccountable manner. As there was no opportunity to fasten a guide to the smooth deck by a mechanical clamp the management of the yard was in somewhat of a quandary until the company's electrician came to the rescue with a magnetic clamp furnished with a guide which could be set anywhere on the deck and would hold fast as long as the magnets were excited. When this was given to the workman with the pneumatic calker he of course found no difficulty in following the seam because he had a straight edge to guide him. The remarkable part of the proceeding followed, however, when the workman further found he could follow the seam without the aid of a straight edge and magnetic clamp and didn't care to bother with the clamp. The consequence is that the clamp now resides in the scrap heap; but who will say that it did not accomplish a useful object, and surmount an obstacle, even if that obstacle was the objection of workmen caused by opposition to labor-saving devices.

Electricity and Gas in Massachusetts.

The thirteenth annual report of the Massachusetts gas and electric light commissioners for 1897, has just been issued. It covers the operations of 134 corporations, of which 45 are gas companies, 24 gas and electric light, and 65 electric light, for the year ending June 30. The earnings of the gas companies compare as follows:

	1897.	1896.	1895.
Gross	$6,046,747	$6,043,652	$5,280,887
Expenses	4,140,762	4,219,254	3,770,751
Net	1,905,985	1,824,398	1,510,136

Those of the electric light companies are as follows:

	1897.	1896.	1895.
Gross	$4,510,134	$4,187,260	$3,822,196
Expenses	2,888,477	2,739,783	2,542,133
Net	1,621,656	1,447,477	1,280,062

Turin Exhibition of 1898.

International Electrical Section.—It has been officially announced that the exhibition authorities will give a premium called the "Galileo Ferraris Prize," amounting to 15,000 lire (about $3,000), to the person who will show at the exhibition an invention, a machine, an apparatus or a number of combined machines or apparatus, whose application will tend to advance the industrial application of electricity. Only those inventions will be considered which are shown at the exposition and which can be experimentally tested. Italians as well as foreign exhibitors can compete for this premium, the award of which will be decided by an international jury. This jury will be elected by the executive committee in conjunction with the Chamber of Commerce and will be completed by a choice of the leading commissioners of the International Electrical Section.

PROF. R. B. OWENS, of the Dept. of Electrical Engineering of the University of Nebraska, Lincoln, Neb., has now been appointed Director of the Bureau of Electricity of the Omaha Exposition, which opens June 10.

An Electrical Exhibition for Philadelphia in June.

Our readers will be interested to learn that the Philadelphia Electrical Exposition Company will give an electrical exhibition in its building, 818 and 820 Chestnut street, beginning June 6, 1898. It will last one month. There has been no such exhibition given in that city since 1884. Public interest will be aroused by a systematized attempt to place before it all the progress of electricity during the interval. Especial efforts have been made to interest distinguished inventors. While the exhibition will necessarily be commercial, no pains will be spared to make it of the highest scientific character and instructiveness. Much thought and time will be given to tasteful decorations and the best of music will be furnished. Many of the exhibits will be such as have never been brought before the public up to this day. The kinetoscope will be employed for a series of moving pictures of military and naval subjects of peculiar interest at the present moment. Extraordinary pains will be taken to have phonograph addresses from distinguished men delivered at stated hours. The management has obtained the services of Prof. William D. Marks as director. His former experience as manager of the Franklin Institute exhibition and his intimate knowledge of the advances in electricity will be guarantee that nothing of interest in the latest advances of scientific discovery will be omitted.

OBITUARY

Jules Viennot.

Jules Viennot, a well-known Philadelphia business man, died in that city on March 11 after a brief illness, in his 73d year. Mr. Viennot was born in Paris and came to this country about 40 years ago. Some 20 years later he reached and established himself in business in Philadelphia. He was a member of the Franklin Institute and of the French Benevolent Association. About two years ago he had the honor of Officier de l'Academie bestowed upon him by the French government. Mr. Viennot conducted one of the largest advertising agencies in the country, and by his strict integrity and upright dealings he had been able to number among his clientage numerous large firms. A widow and daughter survive him.

Sir Henry Bessemer.

Sir Henry Bessemer, F. R. S., known the world over by the invention of Bessemer steel, died in London, England, March 14. He was born in Hertfordshire, and early developed a talent for modeling, designing and mechanical invention. At the age of 20 he was an exhibitor at the Royal Academy. His discovery of the means of rapidly and cheaply converting pig iron into steel, by blowing a blast of air through the iron when in a state of fusion, was the result of costly and laborious experiments, which extended over a long period, and in which the end was attained only after many and disheartening failures. The development of the process has been of incalculable value to the iron industries of the world, and Bessemer reaped a fortune from it, as well as marks of distinction from the crowned heads of Europe and from scientific and learned societies. In 1871 he was president of the Iron and Steel Institute and later was made a Fellow of the Royal Society. He was knighted in 1879. He was a member of the American Society of Mechanical Engineers and the American Institute of Mining Engineers. In this country, towns in Alabama and Michigan were named after him.

PERSONAL

MR. LOUIS B. MARKS, E. E., of the Pioneer enclosed arc lamp, has gone abroad for a few weeks.

MR. T. A. EDISON, JR., who was ordered away to Florida for his health, has now returned to New York after a prolonged stay and is much better for the change. He had heard of our early spring and was greeted Monday morning by a thick snowstorm.

MR. W. M. MORDEY, Mr. R. Percy Sellon and Mr. C. E. Hodgkin, so well known in connection with Anglo-Brush interests, are now in this country for a few weeks studying our recent developments in electrical engineering.

MR. F. P. FISH, general consul of the American Bell Telephone Company and General Electric Company, has gone to Europe on a short business trip.

MR. C. L. EDGAR, vice-president of the Boston Edison Company, has sailed this week for Europe on the Normannia, to be gone about three months.

PROF. E. P. ROBERTS, of Cleveland, was a welcome visitor to New York last week. He is busily engaged on a large amount of consulting electrical work, and is building a large electric road in the vicinity of Dayton, O.

SOCIETY & CLUB NOTES

American Institute of Electrical Engineers.

The 123d meeting of the Institute will be held at 12 West 31st street. New York City, on Wednesday, March 23, 1898, at 8 o'clock p. m. A paper will be presented by Prof. Reginald A. Fessenden of Allegheny, Pa., on "Insulation and Conduction."

Chicago Electrical Association on Copper Wire Manufacture.

THE Chicago Electrical Association held a very interesting meeting the evening of March 18, the subject for discussion being the manufacture of copper wire. Mr. C. T. Gage of the Washburn & Moen Company read the paper of the evening. He traced the history of a piece of wire from the mines to the consumer. The Lake Superior copper deposits were explained and the process of mining there used. The Lake Superior miners find copper in its pure native state scattered in small particles through the rock. After following the copper to the wire mill, where it is rolled into rods and then drawn into wire, he took up the different coverings used on electric wires, giving their derivation and process of preparation. C. H. Sewall, in the discussion of the paper, spoke a word in favor of jute and paper versus rubber insulations for electric light and power underground cables. He said that the impression that such insulations would give out the moment the lead covering was broken was not based on fact. The jute or paper insulations being thicker, offered more obstruction to static discharges. Mr. Scheible questioned the statement that pure ozokerite is the only compound used on weatherproof wire. Wire factories, he said, used large quantities of asphalt, and he didn't know what it could be used for unless it was for weatherproof wire. He mentioned the importance of curing the rubber cores of wires under pressure.

At the next meeting of the association, April 1, H. H. Cutler will lecture on "Motor Regulation and Protection," and it is expected there will be a large and interested attendance.

Northwestern Electric Light Convention.

At a meeting of the committee having in charge the summer meeting of the Northwestern Electric Light Convention—present Messrs. Norcross, Korst, Doherty and Hill—the following resolution was put to vote and unanimously carried:

Resolved, That as a committee of the Northwestern Electrical Association, we accept the invitation of the cities of Duluth and Superior to visit those cities next June.

That Mr. J. M. Hill of Chicago is authorized by this committee to make arrangements with any steamboat company for a summer meeting of said association, to be held en route from Chicago via Sault Ste Marie, Hancock and Houghton, to Duluth. P. Norcross, chairman; P. H. Korst, Henry L. Doherty, J. M. Hill.

NEW YORK HARBOR. Cables and land telegraph lines are being laid and built to connect all the fortifications in the vicinity of New York and the bay and sound.

ELECTRICAL EXHIBITION. FROM MAY-2 TO MAY-31-

Novel and Interesting Features for the Show.

MR. FRED CATLIN, the manager of the telegraphic tournament, has completed the preliminary arrangements for that contest and has arranged the classes. Circulars on this subject will be ready this week for general distribution, and there is already a great demand for information on the subject from all parts of the country. Mr. Catlin informs the exhibition management that the entries will probably be more numerous than at any other tournament that has occurred and thinks that some of the records will be phenomenal. It is proposed, in addition to the regular contest, to have interesting exhibits of telegraphic skill in novel directions. Mr. Jesse H. Bunnell, the electrical manufacturer and veteran operator, is taking a deep interest in the contest and has volunteered to equip the whole stage with the necessary apparatus for the competition, in the shape of keys, sounders, batteries and auxiliary appliances. Mr. Bunnell is desirous to have a separate prize offered for an "old-timers' class," and has already entered himself for that contest. He has the reputation, dating from the war, of being an unusually fast and skilful operator.

Mr. H. V. Parsell, the well-known banker of this city, who has long been interested in electric deposition work, has kindly placed in the hands of his son, Mr. H. V. Parsell, Jr., the electrical engineer, for exhibition at Madison Square Garden during May, a marvelous collection of galvanoplastic work, done during a long series of years. It may be doubted whether any other amateur could possibly show anything approaching this remarkable collection in beauty and interest. It will not only include several striking pieces, as large as 25x25 inches, and reproducing celebrated works of art and famous men, but will comprise large number of coins, medals and fac-similes of antique gems. The most extraordinary part of this beautiful collection, however, will be that which embraces the reproductions from natural objects. It is safe to predict that there will be a crowd around these exhibits all the time. The manner in which they are made, for example, is of deep interest. There are, for instance, snakes and frogs which have been made to the life and from the life. The snake is etherized under a bell jar, then taken out and greased with sweet oil and replaced in the bell jar, while a sufficiency of thin plaster is mixed with warm water. The snake is then placed on a glass plate and posed. Around him is built an enclosure of four square bars, and the plaster is slowly poured over the snake, the bars confining the cast in a rectangular shape. When the plaster is hard it is freed from the sticks and glass plate and the now defunct reptile is carefully removed, tail first, from his intaglio impression. The plaster cast thus obtained is rendered waterproof by immersion in molted paraffin. A metallic conducting surface must now be given to the interior of the cast. This is done by moistening the surface of the mould with a solution of silver nitrate and by exposure to sulphuretted hydrogen, precipitating the silver on the cast. A conducting wire is now fastened around the edge, and the mould is carefully suspended in the depositing bath. A good, firm coating takes about three days to form, and then the mould is softened in boiling water and carefully broken off.

People have often heard of the incinerating effects of high frequency currents, but rarely get any practical demonstration. The attention of the electrical and popular press has lately been drawn to the grim fate of various birds that had, in an unfortunate moment, perched on some of the high tension wires of the power transmission circuits in California. Mr. George P. Low, the well-known electrical engineer of San Francisco, has preserved the remains of two eagles, some storks and other birds, which had short circuited part of the current while sitting on the wires, with the result of leaving only their beaks and talons, not a vestige of their bodies or feathers being discovered. Mr. Low is forwarding these curious relics to the electrical exhibition, where they will be mounted in such a position as to show how the thing happened and just what happened. It will be the first exhibition of the kind that has ever been made.

It is proposed at the exhibition to have amongst other railway apparatus a working model of track intended to demonstrate the operation of the third-rail system as applied to steam railroads. Colonel N. H. Heft, the electrical engineer of the N. Y., N. H. & H. Railway Company, whose work is so widely known in connection with the successful third-rail line between Hartford and New Britain, Conn., has very kindly placed at the disposal of the management blue prints showing the construction of the track and some of the actual material used. The model track, from 50 to 100 feet long, single and double, and about 5 inches gauge, is now being constructed on Colonel Heft's plans, and will be shown in actual operation during the continuance of the show, the details of the track being imitated as closely as the conditions will allow. Over this track a train of cars will run to and fro continually, showing how the current is picked up and delivered to the motor and how the switches and signals are included in the operation.

LEGAL NOTES

The Shaw Three-Motor Electric Crane Patent Declared Void.—The Shaw Electric Crane Co. vs. Shriver.

THIS case came up before the U. S. Circuit Court of Appeals upon an appeal by complainant from a decree of the Circuit Court, Southern District of New York, entered March 16, 1897, dismissing the bill. The suit was brought for infringement of letters patent of the United States No. 430,487, granted to Alton J. Shaw, June 17, 1890, for an electric crane. The patent came first before Judge Acheson, sitting in the District of New Jersey, in a suit by the same complainant against Henry B. Worthington, incorporated, charging infringement of the first, second and tenth claims of the patent. It was held void for want of invention in an opinion, which will be found in 77 Fed. Rep., 992. The suit in the Southern District of New York charged infringement of the first and third claims; the Judge who heard the case followed Judge Acheson's decision and wrote no opinion.

The U. S. Circuit Court of Appeals, in its opinion, says: The record is a most voluminous one, covering 1,700 printed pages; six experts of unquestioned ability have been examined, three on a side; the briefs are able, ingenious and exhaustive, and yet, when the record has been read, the briefs studied and the testimony of the experts analyzed, it is apparent that the question presented is, after all, a single one, which may be answered without any extended discussion. Indeed, it seems unnecessary to add anything to the brief opinion of the Court in the District of New Jersey. The claims in question are: "1. In combination with a supporting track, a bridge mounted and movable thereon, a trolley or car mounted and movable upon the bridge, a hoisting drum or pulley carried by the trolley, and three independent electric motors, each in communication with a source of electricity, one of said motors being carried by and serving to propel the bridge, and the other two being carried by the trolley and serving respectively to propel the trolley and to actuate the drum or pulley.

"3. In a traveling crane, the combination of a bridge, an electric motor carried by and serving to propel the same, a trolley mounted upon the bridge, and an electric motor carried by the trolley wholly independent of the first and serving to propel the trolley over the bridge."

After discussing the evidence, the Court of Appeals quotes the conclusion of the Circuit Court, expressed in Shaw Electric Crane Co. vs. Worthington, that: "The differences between the cranes of Force and Newton and the crane of the patent in suit are simply such as would naturally be made in changing the motive power, and whatever of superiority over previously used traveling cranes is to be found in the crane of the patent is due altogether to the recognized advantages inherent in the electric motor."

The decree of the Circuit Court was affirmed with costs.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued March 8, 1898.

Alarms and Signals:—

GAGE ALARM. H. Cunderman, Brookfield, Wis., 600,244. Filed July 7, 1897. The pointer makes contact to close an electric circuit when it reaches a predetermined point on the dial.

SIGNALING APPARATUS. V. K. Spicer, Kenilworth, Ill., 600,384. Filed April 27, 1897. A combination of mechanical devices whereby a suitable motor may be put into operation for shifting the signal to safety position and to lock it in such shifted position, the locking and shifting mechanisms being controlled by train movements.

SIGNALING APPARATUS. V. K. Spicer, Kenilworth, Ill., 600,385. Filed July 13, 1897. Automatic signals for railways; details of construction.

Batteries, Primary:—

GALVANIC APPARATUS. G. H. A. Schaefer, Buffalo, N. Y., 600,380. Filed January 7, 1898. An arrangement and combination of batteries, connecting wires, switchboard, and inclosing cabinet, in which economy of space and portability are considered.

ELECTRICAL BATTERY. N. B. Stubbelfield, Murray, Ky., 600,457. Filed October 24, 1896. A battery for use with water as an electrolyte, comprising a voltaic couple of insulated copper wire and bare iron wire closely wound into a coil body.

Conductors, Conduits and Insulators:—

INSULATING CONNECTION. H. E. Pearce, Brooklyn, N. Y., 600,336. Filed May 18, 1897. Embodies a top bracket formed with a hub, whose opening is larger than the diameter of the supporting pipe, and set screws in the hub for attaching the connector.

ELECTRICAL INSULATOR AND METHOD OF MAKING SAME. J. W. Boch, East Liverpool, Ohio, 600,475. Filed Oct. 23, 1897. Comprises two or more parts of clay, coated with glazing material, fitted together, supplying extra glazing material at the joints between the petticoats and firing the united and coated parts with the petticoats uppermost. See description on page 330.

Distribution:—

POLYPHASE CURRENT TRANSFORMER. C. Kurda, Nuremberg, Germany, 600,228. Filed Nov. 5, 1896. Consists of two or more sets of inducing coils of different phase placed one upon another, in combination with laminated sheet-inductive material surrounding the sets of inducing coils and separating them from each other.

Electro-Metallurgy:—

APPARATUS FOR WASHING AMALGAM. H. C. F. Störmer, Christiana, Norway, 600,211. Filed June 26, 1895. Comprises a vessel containing a layer of mercury as cathode and an anode, a mixer consisting of a plate normally immersed in and of the same superficial area as that of the cathode, and means for imparting to the plate a reciprocating motion.

TREATMENT OF METALLIFEROUS ORES AND PRODUCTS. E. A. Ashcroft, Melbourne, Victoria, 600,351. Filed Feb. 4, 1897. Consists in circulating a zinc bearing solution around the metallic cathodes of an electrolytic apparatus, the anodes consisting of the matte of the products resulting from the preliminary furnace treatment of products or ores containing copper and iron.

Electro-Therapeutics:—

ELECTRICAL SURGICAL ENGINE. A. W. Browne, Prince's Bay, N. Y., 600,135. Filed Oct. 19, 1897. Details of construction.

THERAPEUTIC ELECTRODE EXERCISING APPARATUS. A Martin, Paris, France, 600,230. Filed Nov. 23, 1897. Embodies a counter with a graduated spring balance for indicating the power developed.

THERAPEUTIC ELECTRODE. J. S. Muir, San Francisco, Cal., 600,290. Filed Aug. 24, 1897. Consists of an electro-chemical decomposing cell of porous material adapted to contain an electrolytic fluid, and electro-conducting rod extending thereinto, and means whereby a current may be passed through the electrolyte within the porous cell.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. J. H. Duncan, San Francisco, Cal., 600,277. Filed July 13, 1897. Comprises a fixed upper frame carrying the actuating magnets, upper carbon and clutch mechanism therefor, a lower movable frame normally upheld by the spring carrying the lower carbon and acting as a trip for the clutch mechanism and connections, whereby the lower movable frame is controlled by the actuating magnets.

Measurement:

ELECTRICAL MEASURING INSTRUMENT. A. H. Hoyt, Penacook, N. H., 600,265. Filed July 2, 1897. Comprises a graduated scale and a pointer whose movement thereon is caused by the current on the circuit, and suitable mechanism for preventing a return movement of the pointer to zero should the current be diminished.

Miscellaneous:—

ELECTRIC HEATER. R. J. Holland, New York, 600,285. Filed Dec. 24, 1896. Provides a flexible liquid-holding receptacle, with an electric heating apparatus adapted for applying local heat uniformly to any particular part of the body.

AUTOMATIC REGULATOR FOR ELECTRIC CURRENTS. J. D. C. Chateau, Paris, France, 600,356. Filed July 10, 1897. An apparatus for lighting and extinguishing gas burners at a distance.

ELECTRIC HEATER. E. E. Gold, New York, 600,417. Filed Aug. 12, 1897. Comprises a helix of resistance wire coiled into a compound helix combined with a support therefor, the helix being compressed against the support so that it exerts an expansive tendency.

Railways and Appliances:—

TROLLEY WIRE SYSTEM. W. J. Kauffman, E. W. Conkell and O. F. Kaufman, Canton, Ohio, 600,202. Filed June 5, 1897. Details of construction.

ELECTRIC RAILWAY. J. F. Scherpe, deceased; L. Scherpe, administratrix, St. Louis, Mo., 600,381. Filed Aug. 12, 1897. Relates to sealed switch boxes for underground trolley electric railways.

MEANS FOR ARRESTING MOTION OF ELECTRIC CARS. W. C. Anderson, West Hoboken, N. J., 600,252. Filed Aug. 30, 1895. The principle employed is that of converting the motors into generators and consuming the momentum of the cars in driving the generators upon a closed short circuit.

Classified Digest of U. S. Electrical Patents Issued March 15, 1898.

Alarms and Signals:—

AUTOMATIC FIRE ALARM. R. J. Baker, Baltimore, Md., 600,765. Filed April 28, 1897. Employs thermostats to complete circuit.

Batteries, Primary:—

GALVANIC BATTERY. E. Habermann, Michigan City, Ind., 600,719. Filed October 7, 1897. Comprises superposed battery elements, a wick disposed between and in contact with both elements, and an exciting fluid isolated from the elements and in which a portion of the wick is immersed.

PRIMARY BATTERY. J. E. Fuller, New York, 600,850. Filed April 5, 1897. Strong solution battery designed for operating bicycles or carriage lamps.

Batteries, Secondary:—

METHOD OF MAKING SOLUBLE METAL ELECTRODES FOR ACCUMULATORS. J. Julien, Brussels, Belgium. Consists in depositing on a copper plate, by electrolysis, a finely-porous surface of pure copper, then amalgamating the copper surface so produced, and finally depositing on the amalgamated surface a coating of zinc to form the active surface of the electrode.

Conductors, Conduits and Insulators:—

INSULATOR SUPPORT FOR ELECTRICAL CONDUCTORS. F. Benedict, Niles, Mich., 600,607. Filed September 13, 1897. Consists of a clamp comprising a plate, a strap secured to it by a bolt, an insulator secured upon the upper end of the bolt and a cross-piece secured to the lower ends of the strap.

Measurements:—

ALTERNATING CURRENT METER. G. Hummel, Munich, Germany, 600,616. Filed October 30, 1897. Consists of an alternating current meter of the Ferraris motor type, wherein a lag of approximately 90 degrees between the main and shunt magnetizing influences is brought about without the necessity of introducing a separate inductive resistance.

Railways and Appliances:—

CONTROLLER FOR ELECTRICALLY PROPELLED VEHICLES. R. T. D. Brougham and W. C. Bersey, London, Eng., 600,509. Filed December 13, 1897. Comprises a switch lever having a slot in it, a foot lever carrying a pin working in the slot, a brake-lever and a flexible connection between the foot and brake levers.

DEPRESSIBLE RAIL SYSTEM FOR ELECTRIC RAILWAYS. W. Grunow, Jr., Bridgeport, Conn., 600,527. Filed April 12, 1897. A contact receptacle is employed containing mercury, the depressible rail being movably supported above the receptacles upon the upper portion of a reciprocating contact device, adapted to be depressed into the mercury.

PROTECTIVE APPLIANCE FOR ELECTRIC RAILWAYS. L. E. Walkins, Springfield, Mass., 600,564. Filed July 17, 1897. Consists of parallel girders supported by pillars, one on each side of the third rail, and being separated by four inches of space at their inner edges.

Switches, Cut-Outs, Etc:—

QUICK-BREAK ELECTRIC SWITCH. T. E. Drohan, Chicago, Ill., 600,523. Filed November 13, 1897. Embodies an auxiliary blade to divert the current from the main contacts at the time of breaking the circuit.

CUT-OUT. A. R. McNeill, Oldfields, W. Va., 600,593. Filed October 7, 1897. Designed for telegraph and telephone circuits and provides means whereby any single instrument may be cut out at the owner's pleasure and the main line be closed.

AUTOMATIC SAFETY CIRCUIT CLOSER AND CUT-OUT. W. L. Pratt, Adams, N. Y., 600,743. Filed May 13, 1896. Comprises a movable arm having loop connections, a fuse wire, a device acting as a magnet, a pivoted armature, and a needle which is caused to move by the armature, and a fuse wire having its ends bent so that the needle can make connections with either end.

PATENT NOTES.

Report on International Patents.

The full report of the conference of the Union for the Protection of Industrial Property, which met at Brussels in December last, has been received from the delegates representing the United States, Bellamy Storer, United States Minister to Belgium, and Mr. Francis Forbes, and is of marked interest. There were present at the conference not only delegates from fifteen of the States of the Union, but also from seven countries which have not yet adhered to it, among them Germany and Japan.

The propositions for amendment of the convention, submitted by the United States, looking toward reciprocity in the matter of fees and the requirements of working and the matter of invention belonging to certain classes, which are patentable in the United States, but not in certain other countries, were held by the conference to be contrary to the general spirit of the convention, but several solutions of the difficulties complained of were suggested which would not be obnoxious to it.

The United States delegates took an active interest in the discussion of changes proposed in the agreement respecting the

international registration of trade marks, though this country is not at present a party to it. The purpose of this agreement is to make the international bureau at Berne the center of a cheap registration which shall be efficient over the territory of the adhering States. Such a registration is regarded as extremely desirable, and is practically a necessity if our manufacturers are to be protected in their foreign trade.

Annexed to the report are a number of papers of great interest. Among these is a statement made by the German delegates, in which they urge the extension of the delay of priority to one year instead of seven months, and the abolition of forfeiture of patents for non-working.

Among the other papers is a statement showing the requirements as to working the invention made in certain countries. In some failure to manufacture the invention in the country within one year invalidates a patent. In others two years, or even three years, are allowed, and importation of goods made under the patent is prohibited. This means that the manufacturer of an American invention must establish factories in each of these countries, or give up patent protection in those countries, and is a very onerous requirement.

REPORTS OF COMPANIES

Hudson River Telephone Co.

At the annual meeting of the Hudson River Telephone Company reports were submitted showing that the company earned over 5½ per cent. during the year on its capital stock. The company has paid a regular quarterly dividend of 1 per cent., or 4 per cent. for the year. In the thirty-eight exchanges operated by the company, the aggregate number of subscribers increased from 5,454 to 6,488, a gain of 1,034. New exchanges were built at Northville, Philmont, Chatham, Coxsackie, Millbrook, Brewsters, Fonda and Wappinger's Falls, N. Y., and Newton, N. J. The most important work to be considered at once are additional circuits on new lines: Whitehall to Glens Falls, Saratoga to Albany via Schenectady, Saratoga to Schuylerville, with additional metallic copper circuit from Saratoga to Greenwich; Fonda to Canajoharie and Fort Plain; Albany to Schoharie; Middleburg and Cobleskill, and extending same from Cobleskill to Sharon Springs; building new line along the U. and D. R. R., from Kingston to Sing Sing, Poughkeepsie to Newburgh, Middletown to Monroe, Middletown to Warwick, Middletown to Ellenville, Port Jervis to Newton, N. J., via Milford, Pa.; Tuxedo to Sufferns, Newton, N. J., to Stanhope, N. J.; Milford, Pa., to Bushkill, Pa.; Port Jervis, N. Y., to Honesdale, Pa., and Catskill to Saugerties.

Annual Report of Electric Storage Battery Co. of America.

The Electric Storage Battery Company issues this statement for the calendar and fiscal year 1897:

Shipments	$842,963.09
Manufactured products sold and not yet shipped	101,594.35
Materials, in process and stock on hand, increase over 1896	14,476.22
	$959,033.66
All expenses, taxes and interest	633,742.74
	$325,290.92
Income from royalties and investments	14,718.07
Net profits	$340,008.99
Fixed charges, interest on bonds	18,200.00
Net income	$321,808.99
Charged off for depreciation	64,064.57
Net surplus	$257,744.42

Sales were $1,026,925.65 in 1897, against $572,281.56 in 1896, increase $454,644.09; net profits $340,008.99, against $148,799.60, increase $191,209.39. The company has $4,000,000 preferred stock on which 3 per cent. dividends have accumulated, and $8,500,000 common stock, the only debt being $450,000 5 per cent. bonds. The year's net income would allow payment of 3 per cent. on common, but the business has developed enormously, and the money probably will be used in its extension.

THE STOCK MARKET

A Firm But Anxious Market.

Another week full of anxiety, rumor and sensation has been gone through, and still others appear to be ahead; but the stock market, wonderful indicator of the national pulse, remains very steady. The general condition of trade is also excellent. During the past week 16,200 shares of Western Union were sold around 85½. General Electric, on sales of 17,690 shares, rose from 30⅝ to 32⅝. In Boston, American Bell Telephone declined to 244½, on sales of 982 shares, and copper stocks there also declined sharply, despite the briskness in that metal.

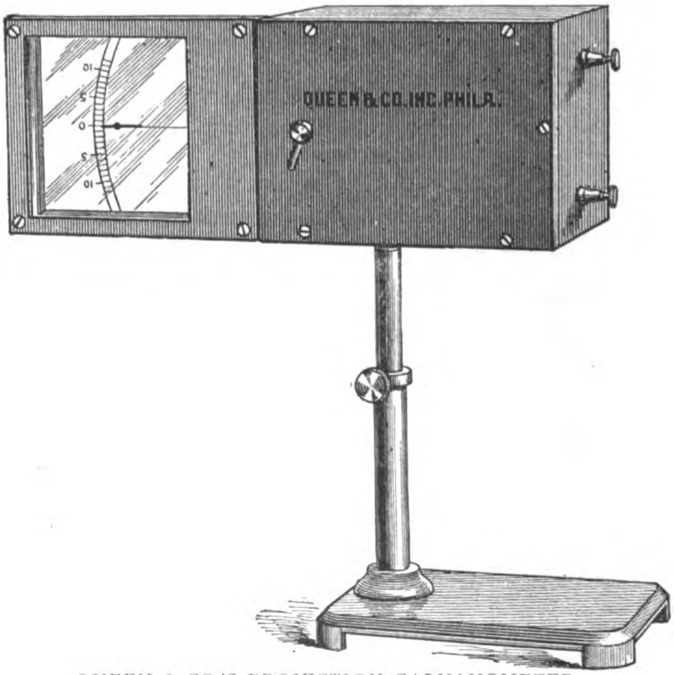
Copper is now quoted at 12 cents per pound, and seems likely to stay up. Heavy steel rail, Eastern mill, is quoted at $17.50.

A certain activity has been given to various branches of electrical manufacture by the demands for government work. Such orders are marked "rush" and have been given priority in execution. Export trade continues large, with new inquiries all the time.

TRADE NOTES & NOVELTIES

A New Queen Galvanometer.

A NEW galvanometer has been recently placed on the market by Queen & Company, Inc., of Philadelphia. It is termed a projection galvanometer and is designed for use in projection lanterns. As shown in the illustration, the galvanometer is attached to a telescopic support, enabling its height to be adjusted to that of the slide holder in the lantern. The scale is etched on plate glass and when projected on the screen is readily seen. The instrument is dead-beat, an important point



QUEEN & CO.'S PROJECTION GALVANOMETER.

when results are desired quickly and easily. The sensibility is very high, but it may be reduced with a shunt when too great. A series resistance enables the instrument to be adjusted to read directly in volts. A shunt resistance permits of calibrating it in amperes.

Those who have had occasion to use the projection galvanometer pronounce it a most convenient addition to the lecture room, and, moreover, when not desired for lecture purposes, the high sensibility and dead-beat character render it thoroughly suited to Wheatstone bridge measurements. When not used in the lantern a slip of paper behind the scale brings the numbers and graduations out plainly.

Some Western Electric 1898 Fan Motors.

THE Western Electric Company's desk, bracket and ceiling fan motors, shown in Figs. 1, 2 and 3, are made for 110, 220 and 500 volts, and are so designed that on a 500-volt circuit three 110-volt motors or two 220-volt motors may be operated in series with perfect safety to the motors, and the 500-volt motor can be operated on a 600-volt circuit continuously without

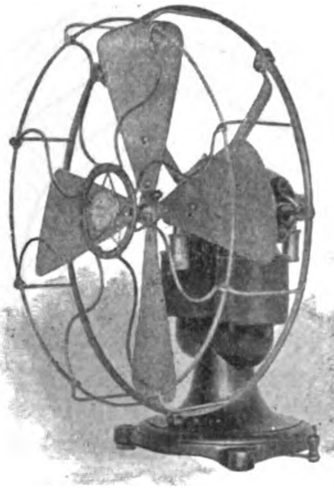


FIG. 1.—W. E. 1898 12-INCH FAN MOTOR, MADE FOR 110 VOLTS, DIRECT CURRENT.

injury. All of these motors are wound for three speeds and are made with self-oiling and self-aligning bearings.

On the desk and bracket motors the switch is placed in the base of the motor, whereas in the ceiling fans it is placed in a

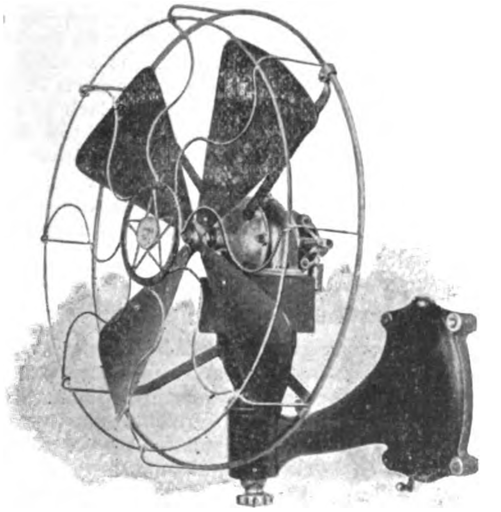


FIG. 2.—W. E. 1898 16-INCH BRACKET FAN MOTOR, MADE FOR 110, 220 AND 550 VOLTS, DIRECT CURRENT.

neat switch box on the under side of the motor casing. The desk and bracket motors are made in two sizes, the blades measuring 12 and 16 inches in diameter; they consist of four wings, it having been demonstrated that a four-blade fan is much more efficient than one with six blades. The current consumption of the 12-inch motors is much less than any 16 c. p. incandescent lamp on the market, while the current consumption of the 16-inch motors is but a trifle more than that required for the ordinary 16 c. p. lamp. The energy required by the 220 and 550-volt motors is practically the same as that required for the 110-volt motors. One very desirable feature is the facility with which the motors can be disconnected from the base and inserted in the bracket. The guard of the motor is made in a most durable manner and is firmly fastened to the motor, which prevents it from jarring. These motors are finished in polished brass, nickel plate or black enamel without additional charge.

All ceiling fans, one type of which is shown in Fig. 3, are so made that chandelier attachments can be readily put on, every motor being wired ready for the sockets, the lead wires being coiled in the top of the switch box when not in service. The

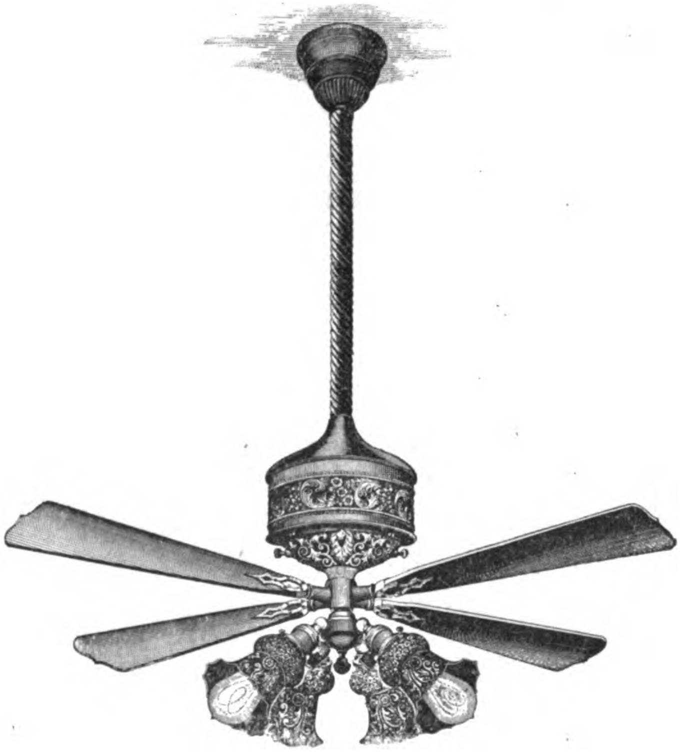


FIG. 3.—W. E. CEILING FAN, WITH LAMP ATTACHMENT.

standard fan consists of four blades, 60 inches in diameter and 8¾ inches wide, and runs at 175 and 185 r. p. m. If desired motors will be furnished with two blades, running at 210 and 215 r. p. m. These fans take but a trifle more current than that required for an ordinary 16 c. p. lamp. All motors are furnished with self-oiling and self-aligning bearings and are perfectly balanced. The stems from which the motors are suspended are usually adapted for 12-foot ceilings. These motors are finished in polished brass, oxidized copper or nickel plate, without additional charge. When ordered, motors will be furnished with one speed, these being made without the switch box and the speed controlling parts.

Carborundum and Some of its Users.

Many expressions and but one opinion are contained in a little pamphlet on "Carborundum and Some of Its Uses," issued by the Carborundum Company, Niagara Falls, N. Y. It contains testimonials from over forty representative firms who have used carborundum for roll grinding in place of emery and for the many other uses to which this splendid grinding material may be put.

Carr Mfg. Co's. Boiler Compound.

The Carr Manufacturing Company, 67 Beverly street, Boston, Mass., have for the past 50 years been manufacturing their superior boiler compound, known as the Yorkshire Boiler Compound, and which they offer to send on trial or approval, not to be paid for unless it gives perfect satisfaction. It may be used in boilers of every description and with all kinds of water, both on land and sea, and, it is claimed, has always been equally effective in removing the formation of scale, whether carbonate

of lime, sulphate of lime, or carbonate of magnesia. It is purely vegetable and it contains none of the injurious ingredients common to many boiler compounds. As a fuel economizer, therefore, its application must be patent to all users. Correspondence is solicited by the Carr Manufacturing Company from electric plants and power stations.

General Electric 1898 Fan Motors.

THE '98 models of the General Electric Company's fan motors are announced as the latest of a long line of successful designs. These fan motors are built for both alternating and direct current circuits.

That for alternating currents is an induction motor, as carefully proportioned in all its parts as are the larger machines which this company builds, excessive wear and heating under continuous operation being as absent from the small as from the large. To the cast-iron frame which supports a single long bearing, are bolted the soft iron laminations which make up the field core, provided with inwardly projecting teeth to form the poles on which are placed the field coils wound with an ample quantity of wire and thoroughly insulated. These are shown in Fig. 1. The armature, Fig. 2, is built up, also of soft iron laminations, assembled on a brass spider, but has no insulated wire. Bare copper rods run through the core, and are riveted into discs at each side. Rotation being produced by inductive action, no commutator or brushes are required. The armature overhangs the bearing, and with the fan, rotates well balanced on

Fig. 1.--Field Core and Coils.

Fig. 2.—Armature.

Fig. 3.—Self-Oiling Bearing.

Fig. 4.—Speed Regulating Device.

G. E. ALTERNATING CURRENT FAN MOTOR.

the single bearing. An automatic oiling device, shown in Fig. 3, gives perfect lubrication without oil throwing, and this, together with the long bearing, insures continuous cool operation. The alternating fan motor is built for 52 and 104 volts 60 and 125 cycles and is provided with a speed regulating device, shown in Fig. 4, consisting of an inductive resistance cut in or out by a three-point switch. Movement of the switch over the first two points gives full speed and half speed and on the third cuts the motor out of circuit. No additional switch is necessary.

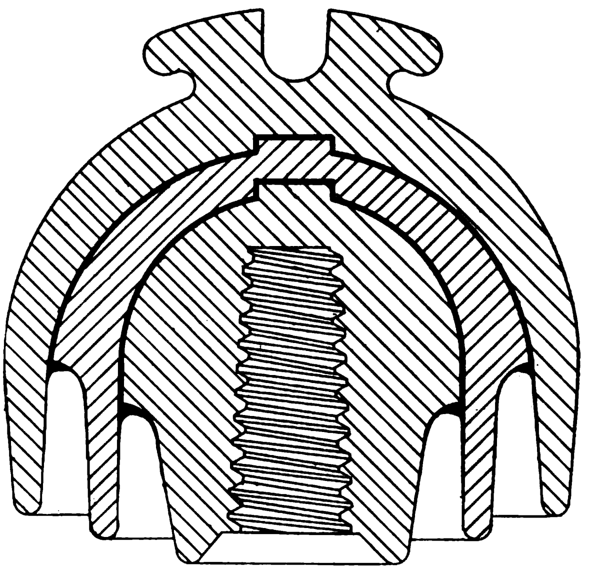
The direct current fan motor is equally as compact and carefully designed as that for alternating currents, and in appearance and general construction closely resembles it. Laminated soft iron of the best quality is used throughout for the magnetic circuit; all windings are thoroughly insulated, and commutator connections carefully made. As in the alternating motor, fan and armature revolve in a single, long, self-oiling bearing. The commutator is completely enclosed and the carbon brushes encased in small tubes, readily unscrewed for inspection. A regulating switch provides for variation of speeds. The alternating current fan motor may be, if desired, mounted on trunnions to allow of adjustment of the fan to blow in any direction.

The motors, which are illustrated in the General Electric Company's advertisement, are finished in black enamel, the fan guard and trimmings in polished nickel.

The Boch High Potential Petticoat Insulator.

A HIGHLY efficient insulator adapted for use on electric lines for the transmission of energy with currents of high voltage has recently been placed on the market by the R. Thomas & Sons Company. It is the invention of Mr. John W. Boch, and is illustrated in section below. It is built up of two or more separately molded parts of clay. The inner portion is pressed or molded with a thread for the reception of the usual pin, and the outer portion, shaped like an inverted bowl, is provided with a cross notch on the top for holding the conductor in place, and has side shoulders by which the conductor may be wired down.

The process of manufacture of the insulator is as follows: The separately molded parts, after coming from the press, are first dried out separately in an oven or kiln by the process known as "biscuit firing." When they have been thoroughly dried and are ready to be put into the vitrifying kiln they are each coated with a glazing material by dipping the portions into the liquid ma-



BOCH'S GLAZE-FILLED HIGH POTENTIAL PETTICOAT INSULATOR.

terial. The parts are then fitted into each other and are stood upside down. Glazing material is then put into the joints, that is, the annular channels between the petticoats. The portions are then put into a sagger with the petticoats uppermost and placed in a kiln, in which, under great heat, the clay shrinks and becomes vitrified, and the glazing material melts and becomes of a glass-like character, adding enormously to the insulation qualities. The glaze which was put into the annular channels flows into and fills all the spaces between the parts of the insulator, that is, such spaces occurring there by lack of correct fit of the parts or arising during the shrinkage by the vitrification of the clay. The extra glazing between the petticoats or at the joints prevents the formation of air spaces or cracks for the entrance of moisture. Every insulator, before it is shipped from the factory, is tested to 60,000 volts by using a specially constructed Westinghouse generator.

Becker Name Plates.

Mr. August Becker, an expert designer and engraver in steel, brass and other metals, of many years' experience, calls the special attention of manufacturers of machinery, electric motors, engines, etc., that he is prepared to furnish engraved name plate castings, index lathe plates and plates for patent dates, etc., in nickel or bronze. Mr. Becker is familiar with the difficulties in procuring thoroughly good designs, well-drawn lettering, clear, sharp and deep cutting. He has been identified with the business for many years, and eminently successful. Being himself a practical workman, and in possession of superior facilities, it is no vain boast to assert his ability to produce the very best work in all lines at the very lowest prices.

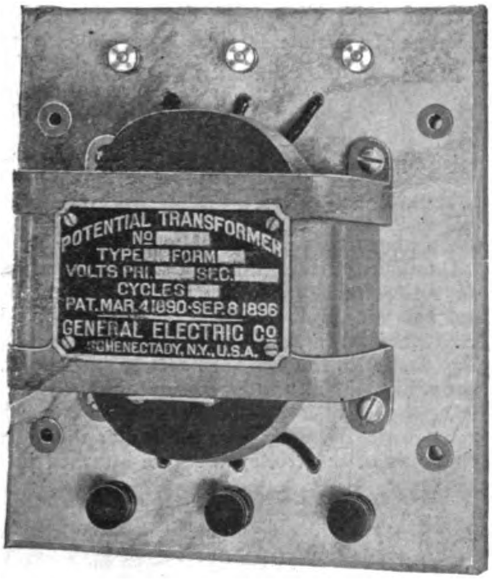
It is not often that the finest quality and the most reasonable prices unite on one article, nor is it frequent that the faculty to design is combined with the skill to engrave in one person. Mr. Becker gains an immediate insight into descriptions of proposed plates and carries out ideas with precision and speed, or invents

new designs as desired. This knowledge of the practical as well as the commercial side of artist's work is always of the highest value to the customer. All patterns are carefully adapted to the form of reproduction required, special pains being taken to obtain depth and clearance for casting in the sand. To those who may not have availed themselves of Mr. Becker's talents in this direction, undoubted reference can be given, sample plates shown, and information, drawings and estimates of proposed work furnished either by mail or interview. His facilities for producing large numbers of plates are unrivaled, and upon such orders he is pleased to make no charge for preparatory work. Mr. Becker would impress on the public mind most particularly the quality of his productions, no plate leaving his workroom without rigid inspection, and without possessing that fineness of finish and perfection of workmanship for which it is his pride to be distinguished. A call by mail or telephone will be responded to promptly, and prospective customers gladly welcomed at his address, 34 Oliver street, Boston.

General Electric Potential Transformers.

POTENTIAL transformers are designed to furnish current for either voltmeters or wattmeters. They are not of sufficient output to load with lights, and they give the correct ratio of transformation at their rated output instead of at no load, as is the case with all other transformers. The rating assigned them is 10 watts, which is ample to supply one General Electric inclined coil voltmeter and one single-phase recording wattmeter. They can be safely loaded to 50 or 60 watts for a few minutes and are thus adapted to furnish current to phasing lamps, in circuit long enough to synchronize the machines to which they are connected.

To meet various conditions the General Electric Company has designed five different potential transformers. The first, wound for 1,040 volts primary and 52 volts secondary for frequencies 60



GENERAL ELECTRIC POTENTIAL TRANSFORMER, 1,040 OR 2,080 VOLTS PRIMARY, 52 OR 104 VOLTS SECONDARY.

to 125 cycles, is intended for use on circuits the voltage of which does not exceed 1,250 volts, to supply current to indicating voltmeters reading to 75 volts and to primary recording wattmeters.

The second, shown in the figure, wound for 1,040 or 2,080 volts primary and 52 or 104 volts secondary, for frequencies of 60 to 125 cycles, furnishes current for indicating wattmeters reading to 75 or 150 volts, and is so wound that coupling the coils differently for use on different voltages is unnecessary. It has ample carrying capacity in the winding to give its full output on the lower voltages when only one-half of the winding is in use. Three primary and three secondary terminals are provided. If the transformer is used on 2,080 volt circuits the outside primary terminals are connected to the line. If, however, it is used on 1,040 volt circuits, the middle terminal and either outside terminal are connected to the line. By making similar connections on the secondary side either 52 or 104 volts can be obtained.

The third, wound for either 1,040 or 2,080 volts primary and 57½ or 115 volts secondary, for frequencies of 60 to 125 cycles, is identical in its construction and use with the second, except that it is wound for stations using a ratio of transformation of 1 to 9 or 1 to 18 in place of 1 to 10 or 1 to 20.

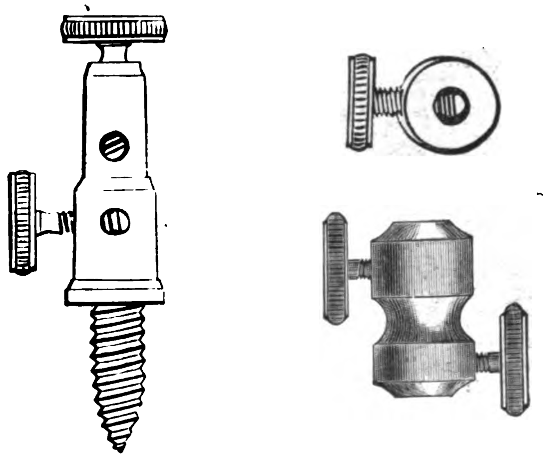
The fourth is so designed that it can be wound for any primary voltage up to 6,000 volts and any secondary voltage up to 115 volts, for frequencies between 60 and 125 cycles. As parts of this transformer are kept in stock, it can be wound on short notice.

The fifth is similar to that just described, but slightly larger. It can be wound for the same voltages, but has a range of frequency from 25 to 60 cycles.

These transformers are designed to supersede all station and meter transformers which have been built by the General Electric Company up to the present time.

The Binding Posts and Connectors Manufactured By the Springfield Machine Screw Co.

The Springfield Machine Screw Company, Springfield, Mass., have for many years been engaged in the manufacture of a full line of screw parts for electrical purposes. With the increasing demand for these goods, this company have from year to year been obliged to add new machinery to their factory to turn out what has now grown to be quite a large and varied line. The



SINGLE AND DOUBLE CONNECTORS AND BINDING POST.

line comprises such parts for electrical uses as connectors, switchboard parts, battery knurled nuts, telephone screws, binding posts of all descriptions and a large variety of special screws, nuts and studs. The accompanying cuts represent their single and double connector and binding post. The Springfield Machine Screw Company solicit correspondence from electrical concerns interested in the line of goods which they manufacture.

The Mica Insulator Co.

The Mica Insulator Company of New York, Chicago and London announce that they have recently made an addition to their already extensive line of oiled cloth and paper insulations and are now prepared to furnish "M-I-C Compound" rope and bond paper. This line of insulation is made from the finest grade of rope and bond paper and treated with two baked coatings of M-I-C compound. The rope paper is furnished in sheets one yard wide, two yards long, and carefully packed between sheets of plain paper. The average break down test is 739 volts per mill. Thickness, 4½ mills. The bond paper is furnished in sheets 19x24 inches and 22x34 inches, the average break down test being 859 volts per mill. Thickness, 5 mills. The company will be pleased to send samples to electrical manufacturers, street railways or lighting stations upon application.

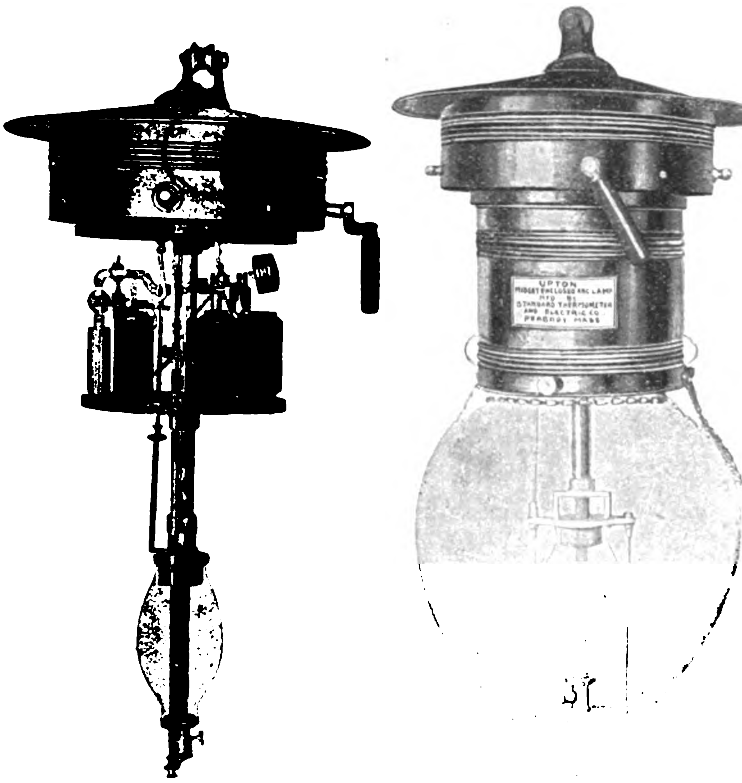
The Rae Motocycle Co.

The many friends of F. B. Rae of Chicago will be interested in knowing that he is becoming interested in the manufacture of motor carriages. The Rae Motocycle Company was recently formed for this purpose. Mr. Rae has a number of novel features which he expects to incorporate in the new electric vehicles, and electric carriage men will await their production with in-

terest. The Rae motor will be used, supplied from the Porter storage battery. The Sterling Cycle Company will build the running gear, so there will be no doubt as to the quality of workmanship.

Upton "Midget" Enclosed Arc Lamps for Direct Current to Burn in Series.

SO complete is the line of arc lamps and special arc lamp appliances placed upon the market by the Standard Thermometer and Electric Company, of Peabody, Mass., that we have been able to publish each week lately some novel type of lamp designed by this company for use on various circuits. The Upton "Midget" enclosed arc lamp, now illustrated in Figs. 1 and 2, is designed to burn two in series on 200 to 250 volt circuits, four in series on 440 volts, five in series on 500 to 600 volts, or five in series on railway or power circuits varying from 450 to 550 volts. Each lamp is provided with sufficient resistance, placed in the cover, to allow of its arc being extinguished without affecting the operation of the remaining lamp or lamps in the series. In case of accident to any one or more lamps of a series, by reason of carbons sticking or similar trouble, the lamp automatically cuts in resistance through which current will flow instead of across the arc. This device does away with the trouble and expense of burnt-out magnets and shunt coils. The lamps will burn 125 hours with one set of carbons, are adjusted and tested under exactly the conditions that they will be used, a rise or drop in the voltage affecting all equally. They are made to take from 3 to 6 amperes as desired. The parts are interchangeable and no soldered connections are used.



FIGS. 1 AND 2.—THE UPTON "MIDGET" DIRECT CURRENT ENCLOSED LAMP FOR SERIES CIRCUITS.

A large number of these lamps are now in use on railway and power circuits and after the most severe tests have proven their efficiency. Street railway companies are enabled to use these lamps five in series on their trolley circuits, as the "Midget" lamps are being operated on circuits showing a variation of 50 to 150 volts. This lamp is also recommended for factories and foundries using 220-volt power circuits, where the lamps can be operated two in series.

JANDUS ELECTRIC COMPANY, Cleveland, O., report that the Navy Department, Washington, has placed a very large rush order with them for Jandus enclosed arc lamps.

"H. W. J." Arc Lamp Hanger.

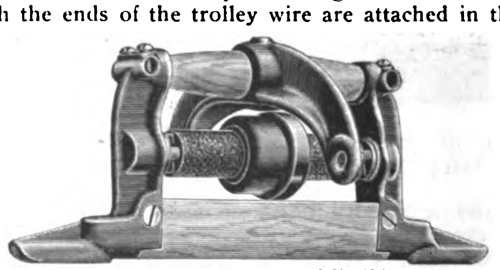
THE "H. W. J." lamp hanger illustrated herewith has been placed upon the market to meet the demand for a practically indestructible, highly insulated and reliable substitute for the porcelain and other arc lamp suspension devices possessing well-known disadvantages. The hanger is furnished with either sister hooks, similar to those illustrated, or with snap hook for the attachment of the eye or fastening at the top of the lamp, with an ample margin of strength to guard against any possibility of the lamp falling to the ground. The hanger with sister hook suspension will support 2,000 lbs. The sectional view shows the internal arrangement of parts, which are thoroughly insulated from each other by sheet mica and further insulated and waterproofed by the filling and exterior shell of moulded mica. Samples submitted to tests at 15,000 volts (the highest obtainable at the time) showed no effects. When immersed in water to the edge of the skirt, samples broke down at 7,000 volts.

"H. W. J." ARC LAMP HANGER, ELEVATION AND SECTIONAL VIEW.

The "H. W. J." arc lamp hanger is sold by the H. W. Johns Manufacturing Company and large sales are anticipated, as the merits of the device become better known. With inexpensive modifications the hanger can also be adapted to serve as a telephone or telegraph cable insulator and for special purposes.

The Hartford "Break."

A section insulator to be practical must be highly insulated, possessed of sufficient strength to withstand all strains of the trolley wire without distortion or fracture, should furnish an unobstructed passage for the trolley wheel and should provide simple and inexpensive means for repairing the parts subjected to wear. The design of the Hartford section insulator, shown in the illustration, is such as to meet these requirements. The tension of the trolley wire is resisted by steel bolts insulated by moulded mica, which securely binds together the end castings, to which the ends of the trolley wire are attached in the usual manner. The top wooden bar resists all strains of compression and completes the strongest form of a frame for the purpose required. The lower wooden bar, which furnishes the insulated run-way for the trolley wheel is held by screws in sockets in the end castings. The bar is, therefore, readily replaceable, when worn, without disturbance to the line, and the section insulator made as good as new by the insertion of a cheap piece of wood. The break is light in weight, is furnished with various suspensions to meet the conditions of line construction, and will undoubtedly attract the attention of all those interested in trolley line insulation and maintenance.



THE HARTFORD "BREAK."

The Hartford section insulator has been placed upon the market by the H. W. Johns Manufacturing Company.

Installations of Erie Ball Engines.

The electric light plant now being placed in the new building of the Peruna Drug Manufacturing Company at Columbus, O., consists of two Ball engines of 160 h. p., built by the Ball Engine Company, Erie, Pa., direct connected to Siemens-Halske dynamos.

The "City of Erie" is the name of a new passenger steamer now being built at Detroit for the Cleveland and Buffalo Transit Company. This boat, which will be one of the most handsomely fitted out on the Great Lakes, will have a large and complete direct connected electric light plant, consisting of Ball engines, built by the Ball Engine Company, and dynamos built by the Fuller Company of Detroit, Mich.

The Shenango Valley Steel Company, New Castle, Pa., are now installing a 450 h. p. Ball engine, built by the Ball Engine Company. The engines are belted to Westinghouse generators and are used to generate power for electric cranes, electric lighting and kindred purposes.

The Sargent Co.

The heavy business so far this year, showing, in fact, an increase of something like 40 per cent. over that for the corresponding period in 1897, has made it imperative for the Sargent Company to considerably increase their capacity. To that end they have recently installed a large twenty-ton electric traveling crane, from Manning, Maxwell & Moore, in addition to the cranes now operated, and an additional saw of the latest and most improved type manufactured by the Q. & C. Company, also rearranging their receiving and shipping departments extensively. In the power house, new engines, dynamos, etc., are about to be installed. They now have a capacity of about 1,000 tons a month, which will, of course, be greatly increased by the changes now in process.

One More Big Westinghouse Generator at Niagara.

On Friday, March 18, the Niagara Falls Power Company tested the fourth great 5,000 h. p. generator placed in their station. The test was a success in every way and highly gratifying both to the power company and to the Westinghouse Electric and Manufacturing Company, the latter makers of the dynamo. This brings the capacity of the station up to 20,000 electrical horse power and is the first of the new dynamos to be installed and operated. Additional dynamos of the same design, make and size will be installed in the power house until the total output of electric current reaches 50,000 h. p.

CATALOGUES.

Catalogue of D. C. Generators and Motors of the Keystone Electric Co.

One of the handsomest and most useful catalogues issued in recent years is that of the Keystone Electric Company, Erie, Penn. This catalogue, which has embossed on its pale green cover a keystone, the emblem of this enterprising company, illustrates in detail every portion of their multipolar generators and motors. Beautiful half-tone illustrations, which give the intending purchaser an insight into the care with which their goods are manufactured, show how thoroughly each detail has been attended to. Following a very complete price list are a number of valuable diagrams showing connections of generators and motors, possible arrangements for belted units and connections of standard switchboard panels for isolated plants on the two-wire system.

Catalogue of the World Manufacturing Co.

Patterson, Gottfried & Hunter, 146-150 Centre street, New York, agents for the World Manufacturing Company, have issued a very useful catalogue and price list of the goods manufactured by this company. They include rubber belting, hose, packing and matting, detachable link belting, Hoppen's adjustable hangers, Johnson's safety collars, and Shaw's compression flange couplings.

NEW YORK NOTES.

HENRY R. WORTHINGTON, New York, has recently issued a new special catalogue devoted exclusively to power pumps adapted to be operated by electrical motors, water power, belts or any other suitable means. This catalogue places before customers a full and complete line of power pumps for all services, from which a selection can be made as readily as from the general steam pump catalogue published by the company. Believing that there is now demand for this class of machinery, the Worthington Company propose to take up its construction with the same care and thoroughness they have given their lines in steam pumps.

THOMAS A. EDISON, JR., is meeting with gratifying success in the sale of his incandescent lamp, which, though only a few months on the market, has now a sale equal to many of the lamps which have been on the market for years. He has just closed a contract with the Illinois Electric Company of 239 Madison street, Chicago, whereby they will act as his agents in Chicago. They will keep a large stock on hand.

THE UNITED CORRESPONDENCE SCHOOLS, 156 Fifth avenue, New York, are offering thorough courses of home study in all classes of engineering. Their courses in electrical engineering are thorough and practical and mechanical drawing, which is included in each course, is taught by modern methods and competent instructors.

NEW ENGLAND NOTES

PARAGON.—That the Paragon lamps are upholding their reputation for reliability is evidenced by the fact that Messrs. G. M. Angier & Company, Boston, report that business still continues good, and that they are booking new orders constantly. Their new short enclosed lamps which they will soon place upon the market for both constant potential and constant current circuits will be a radical departure from anything now in use and will embody several distinctive features likely to demand instant recognition from central stations and users of arc lamps in general.

E. PHILLIPS & SONS, South Hanover, Mass., is an old New England firm which has been identified for many years with the manufacture of pure rolled zinc plates for electrical as well as other mechanical purposes. Their large plant is equipped with the most modern and up-to-date machinery and puts them in a position to fill any order promptly for zinc, as well as making and cutting zinc to order for any purpose whatsoever. This firm solicit correspondence on the subject and will be pleased to quote prices on their product. E. Phillips & Sons' Boston office is at 107 Summer street.

MR. M. L. LIVINGSTON of the Standard Thermometer and Electric Company was in New York last week and spoke in enthusiastic terms of the success of the Upton lamps. There has been a great sale for these lamps among the mills in New England and among the sales of the high tension series arc lamp for street lighting may be mentioned a number burning on 6.8 amperes for Berlin Falls, N. H., and some for the town of Crowley, La.

WESTERN NOTES

WARREN ELECTRIC AND SPECIALTY COMPANY, of Warren, O., have just issued a very pithy and piquant circular entitled "A Roast for a Roaster," devoted to their little quarrel with the "Trust," and delivering some hot fire on the subject under discussion, namely, the real merits of their own and other incandescent lamps. It is a very lively piece of literature.

THE MICHIGAN PIPE CO., of Bay City, Mich., is working on an order of 14,685 creosoted tamarac cross ties for the Denver Consolidated Tramway Company. The latter road purchased 1,600 creosoted ties from the Michigan Pipe Company last year and after investigating the merits of creosoted ties they have placed this large order for their 1898 improvements.

ADVERTISERS' HINTS

DE VEAU & CO., 27 Rose street, New York, show another style of their telephones which are beyond the experimental stage and acknowledged a success.

THOMAS A. EDISON, JR., 96 Broadway, New York, advertises the "Edison, Jr." incandescent lamp, which he guarantees for 600 hours' life.

INSTITUTE FOR HOME STUDY OF ENGINEERING, Blackstone building, Cleveland, O., call attention to the excellence of their engineering course. They say the subscriber has all the advantages of personal attendance.

THE CHICAGO EDISON COMPANY, 139 Adams street, Chicago, Ill., offer a list of apparatus removed from their own central station to make room for larger units.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., call attention to a special generating plant they have just shipped to the Crookston waterworks, described on another page.

THE PRATT & WHITNEY COMPANY, Hartford, Conn., in many sizes and a large variety of other tools, a description of which may be found in their catalogue "B."

C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., mention the coal handling plant they installed for the Brooklyn Heights Railway Company. This plant consumes 25,000 tons annually and the cost of handling, including interest on the investment, is but 3½ cents per ton.

THE CROCKER-WHEELER ELECTRIC COMPANY, 39 Cortlandt street, New York, are building a new form of belt driven machine, which is described in their "ad" in this issue.

THE GENERAL ELECTRIC COMPANY advertise their 1898 styles of fan motors for alternating and direct circuits.

D. A. HEUBSCH, 31 East Rose street, New York, advise firms contemplating the presentation of souvenirs next year to correspond with them now.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, Ill., are making another large addition to their factory to meet the demands for their "'phones, which speak for themselves, and their switchboards, which stand up."

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., have a word to say on economy and how it may be practiced by means of the Holly system of heating by exhaust steam.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., are issuing circulars describing in detail and giving results obtained from installing chloride accumulators for various purposes. They are obtainable by application.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY have installed 35 rotary transformers, aggregating 8,698 h. p.

THE B. F. STURTEVANT COMPANY, Boston, Mass., advertise ventilating fans, one style of which they illustrate.

THE CUTLER-HAMMER MANUFACTURING COMPANY, 70 West Jackson street, Chicago, have placed a large stock of their motor starting boxes with the Holtzer-Cabot Electric Company, 112 Liberty street, New York, to suit the convenience of the Eastern trade.

CARR MANUFACTURING COMPANY, 67 Beverly street, Boston, Mass., will send the Yorkshire boiler compound on trial and will not charge for it unless it gives satisfaction.

AUGUST BECKER, 34 Oliver street, Boston, Mass., continues to manufacture name plates for dynamos, engines, motors, etc., and will furnish estimates to parties interested.

THE KEYSTONE ELECTRIC COMPANY, Erie, Pa., illustrate their class "C" generator.

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., say the war with Spain and their printing press controller are the chief topics of interest at present. The latter is far more certain and there is no arcing or sparking on contacts.

THE SPRINGFIELD MACHINE SCREW COMPANY, Springfield, Mass., manufacture binding posts, switchboard posts, battery screws, nuts and connectors for general and special uses.

R. THOMAS & SONS CO., East Liverpool, O., have just brought out an insulator for high voltage circuits which differs in manufacture from those already on the markets. A fuller description appears elsewhere in this issue.

CONTENTS.

Department News Items will be found in advertising pages.

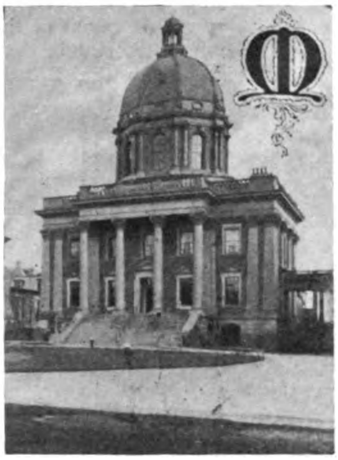
The Electrical Engineer.

Vol. XXV. MARCH 31, 1898. No. 517.

ELECTRIC LIGHTING

The Electric Lighting Plant of the Boston City Hospital.

BY H. W. WELLER, C. E.



Administration Building.

MAYOR QUINCY of Boston is nothing if not progressive, and he is also a great believer in the use of electricity, and owing in large measure to his influence and advice, the trustees of the Boston City Hospital decided about a year ago to install a complete electric installation for the Hospital. The work was placed in the hands of Mr. Cottle, chief of the Electrical Construction Division of the Public Buildings Department, and the brief description of the plant given below shows that the result is one of the finest isolated electrical installations in the country and a credit to all concerned.

In designing and carrying out the installation many difficulties were met with, especially in the wiring of the old buildings, as these were in use the whole of the time, and the greatest care was insisted upon by Dr. Rowe, the genial medical superintendent, to prevent any noise in the wards, occupied by the patients, which might cause annoyance or suffering to the sick. This necessitated the use of screws instead of nails for putting up mouldings, etc., and all cutting, sawing and fitting was done outside the buildings.

POWER PLANT.

This is located in the new power house, shown in Fig. 1, situated on the easterly side of Albany street, directly in the rear of the hospital grounds, a plan of which is shown in Fig. 2. The head house facing on Albany street is 60x40 feet and is built of red brick with marble trimmings, and was designed by City Architect Edmund M. Wheelwright.

The head house, marked 1 in Fig. 2, contains the engines and dynamos, while the boilers are installed in a boiler house 60x50 feet, marked 20 in Fig. 2, in the rear of the head house, with a tank room annexed. The stack is of brick, 100 feet in height and 5 feet in diameter inside. The boiler plant, consisting of six horizontal tubular boilers of 125 h. p. each, was installed three years ago for heating and laundry purposes. In the rear of the boiler room is a coal pocket, with a storage capacity of 3,500 tons, and the coal is unloaded direct from the vessel into this pocket by a Hunt conveyor. Hard coal is used to avoid smoke and dirt about the hospital. The steam is conveyed to the engine room through a steam main 12 inches in diameter, with suitable valves to admit live steam into the heating system when necessary.

ENGINES AND GENERATORS.

The engine room, shown in Fig. 3, is designed for six direct connected units, three of which have been installed. Each unit consists of a 17"x14" "Ideal" automatic engine, direct-connected to an 80 kilowatt 220-volt Siemens & Halske generator. The engines, which run at a speed of 250 revolutions per minute, are designed to operate with an initial steam pressure of 85 lbs. and under a back pressure of 15 lbs. to the square inch, in order to utilize the exhaust steam for heating purposes. This large back pressure is caused by the long distances that the steam has to be carried in the heating mains. When the steam is not required for this purpose it is passed through a Berryman feed water heater and then discharged into the atmosphere. Each engine is piped up with a Stratton separator, and the exhaust steam is passed through an oil separator before entering the heating system. The various steam and recording gauges and clock are mounted on a handsome gauge board of Tennessee marble.

SWITCHBOARD.

The switchboard, shown in Fig. 4, 28 feet in length, consists of 15 panels of polished black Monson slate, mounted on a handsome structure of enameled brick topped with an effective cornice. It is arranged in three sections, the central one of seven panels being used for the generators, and two end sections, each of four panels, which are the feeders. The central panel carries the switches and rheostat for controlling the motor generator, which is used for balancing the three-wire system, and also the volt and ammeters for each side of the system, also those showing the total load on the system and on the neutral bus.

Each of the three generator panels is equipped with a three-pole 500-ampere knife switch, a field switch and rheostat and an illuminated dial ammeter, flush type. Each feeder panel has mounted upon it a 500-ampere double-throw knife switch and an edgewise ammeter in each side of the system. Each feeder is provided with a double coil, double pole, circuit breaker of the Cutter Electrical and Manufacturing Company I. T. E. type. These circuit breakers are arranged so that an overload between the neutral and either outside pole will open both sides of the system, thus avoiding an excessive load on the motor generator. All safety fuses are mounted on independent slate bases

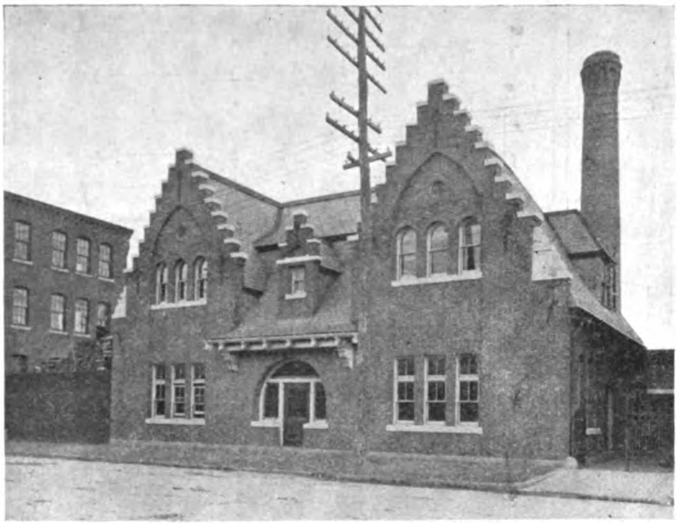


FIG. 1.—POWER HOUSE, BOSTON CITY HOSPITAL.

and installed in rear of the board, where ample space is provided for access. In case of accident to the plant all the feeders can be thrown onto the street service, for which purpose the necessary switches are provided. The volt and ammeters were supplied by the Weston Electrical Instrument Company and the knife switches are of the Murdock type, with adjustable jaws.

The switchboard, as can be seen from the figure, is of entirely novel arrangement and construction, and was designed by Mr. Hatch, the electrical engineer, the rear of this switchboard being practically a room, and has doors at either end, which can be kept locked and so prevent any tampering with the connections or wiring.

The walls of the engine and dynamo room are finished in enameled brick and the floor is of polished birch and the ceiling paneled. A heavy nickel-plated railing separates the visitors' entrance from the main floor and affords ample opportunity for viewing the plant without interference with the employees. There are also nickel-plated guard rails around the engines and generators. A telephone booth, with intercommunicating telephone, connecting with every part of the institution, is also located in the engine room.

WIRING SYSTEM.

On account of the large area covered by the Institution, aggregating over 14 acres, it was found desirable to use the three-wire

system, and this is accomplished by running the generators at 220 volts and balancing the neutral wire by means of a 5 k. w. four-pole Siemens & Halske motor generator. There is also a small auxiliary switchboard in the rear of the main switchboard by which the lights in the power house and stable adjoining can be transferred to either side of the system in case the system gets out of balance beyond the capacity of the motor generator. As a matter of fact the system is so well balanced that the motor generator takes care of the variations with ease.

DISTRIBUTION.

From the power house there are run out four sets of feeders, dividing the grounds into four sections, the south or contagious department, the easterly end of the old yard, and the medical and surgical sides of the old yard. The various buildings of the institution are connected by subways, but as some of them were already overcrowded and unfit for cables, it was decided to cross Albany street and Massachusetts avenue in special ducts. These

All cut-outs are located outside the wards. The fixture work and arrangement of the lights has received a great deal of attention, it being Dr. Rowe's aim to secure an abundance of light without any glare or inconvenience to patients. Up to the present the plant has been used principally for lighting, but it is the intention to extend the use of electricity into many of the branches of hospital service, for which it is so well adapted. There are now connected to the plant about 4,000 lights, besides a 7½ h. p. Westinghouse 4-pole motor running the refrigerating plant, and a small Crocker-Wheeler bipolar motor operating an exhaust fan. To these will be added the motors for more ventilating fans, elevators, ice cream freezers, laundry appliances, Röntgen ray apparatus, precipitators and a complete system of arc lighting for the grounds.

The entire plant was designed and installed by the electrical construction division of the Public Buildings Department of the city of Boston, H. F. Cottle, chief of division, B. B. Hatch, electrical engineer. The engines were furnished by the Boston

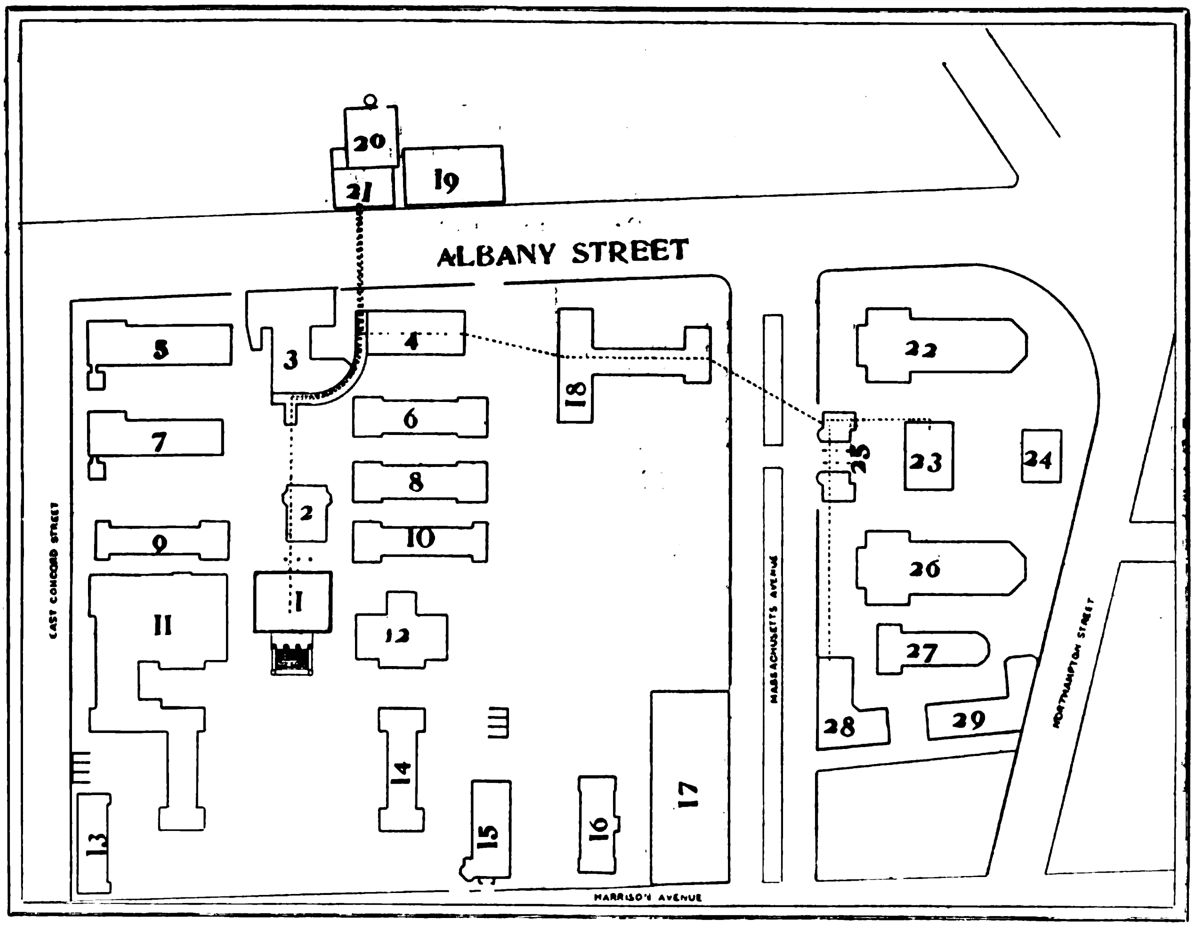


FIG. 2.—PLANS OF THE BOSTON CITY HOSPITAL, GROUNDS AND BUILDINGS.

1. Administration Building.
2. Library.
3. Laundry.
4. Wards K and L, Medical.
5. Isolating Ward.
6. Ward E, Medical.
7. Wards W and X, Surgical.
8. Ward A, Medical.
9. Ward P, Surgical.
10. Ward T, Medical.
11. Surgical Building and Wards B, C, D.
12. Wards Q, R, S, Medical.
13. Surgical Out Patients.
14. Wards F, G, H, Medical.
15. Entrance, and Medical Out Patients.
16. Nurses' Home.
17. Nurses' Home (New Building).
18. Pathological Bldg. and Morgue.
19. Ambulance Station.
20. Boiler House.
21. Dynamo and Engine Room.
22. Contagious Wards.
23. Administration Bldg., Contagious Dept.
24. Domestic Building.
25. Gate Lodge.
26. Contagious Wards.
27. Contagious Wards, Future Ext.
28. Nurses' Home.
29. Laundry.

ducts consist of three-inch steel pipes laid in concrete. Inside the grounds the feeders are carried through the subways on special porcelain insulators bolted to the tops and sides of the subways. At the end of each feeder is a special slate distributing board controlling each circuit. From these distributing boards the mains are distributed to the various wards and buildings. These distributing boards are so arranged that should the system become unevenly balanced the branch circuit connections can be reversed to even up the load. Provision is also made for tieing together two or more feeders in case of accident. The wiring loss from switchboard to lamps is figured at five volts. The wiring of the wards and other buildings is done in mouldings, except in the new buildings, in which iron armored conduit is used.

office of W. R. Fleming & Company, agents for the Harrisburg Foundry and Machine Works, and the dynamos by the Siemens & Halske Electric Company, H. C. Spauding, Boston agent. The steam fitting for the electric plant was laid out by Engineer Howard of the City Engineering Department and executed by Ingalls & Kendricken of Boston. The foundations, piers and switchboard setting were built by A. D. Jones of Boston, and the switchboard by Wm. J. Murdock & Company of Boston. The fixtures were supplied by McKenney & Waterbury and R. Hollings of Boston, and the wires and cables by Eastern Electric Cable Company and Simplex Electrical Company.

OTHER CITY PLANTS.

Besides the above, the following smaller plants have been in-

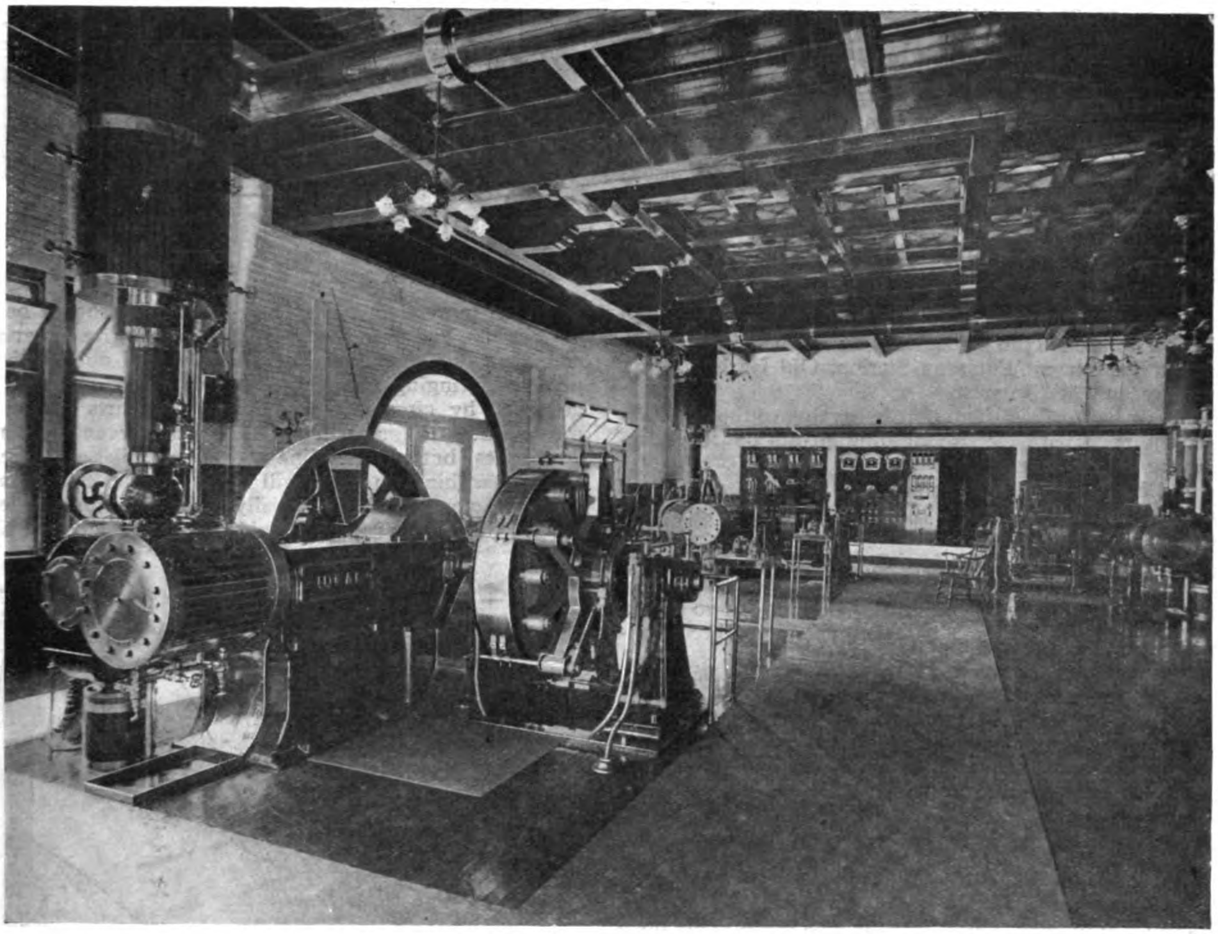


FIG. 3.—ENGINE AND DYNAMO ROOM, BOSTON CITY HOSPITAL.

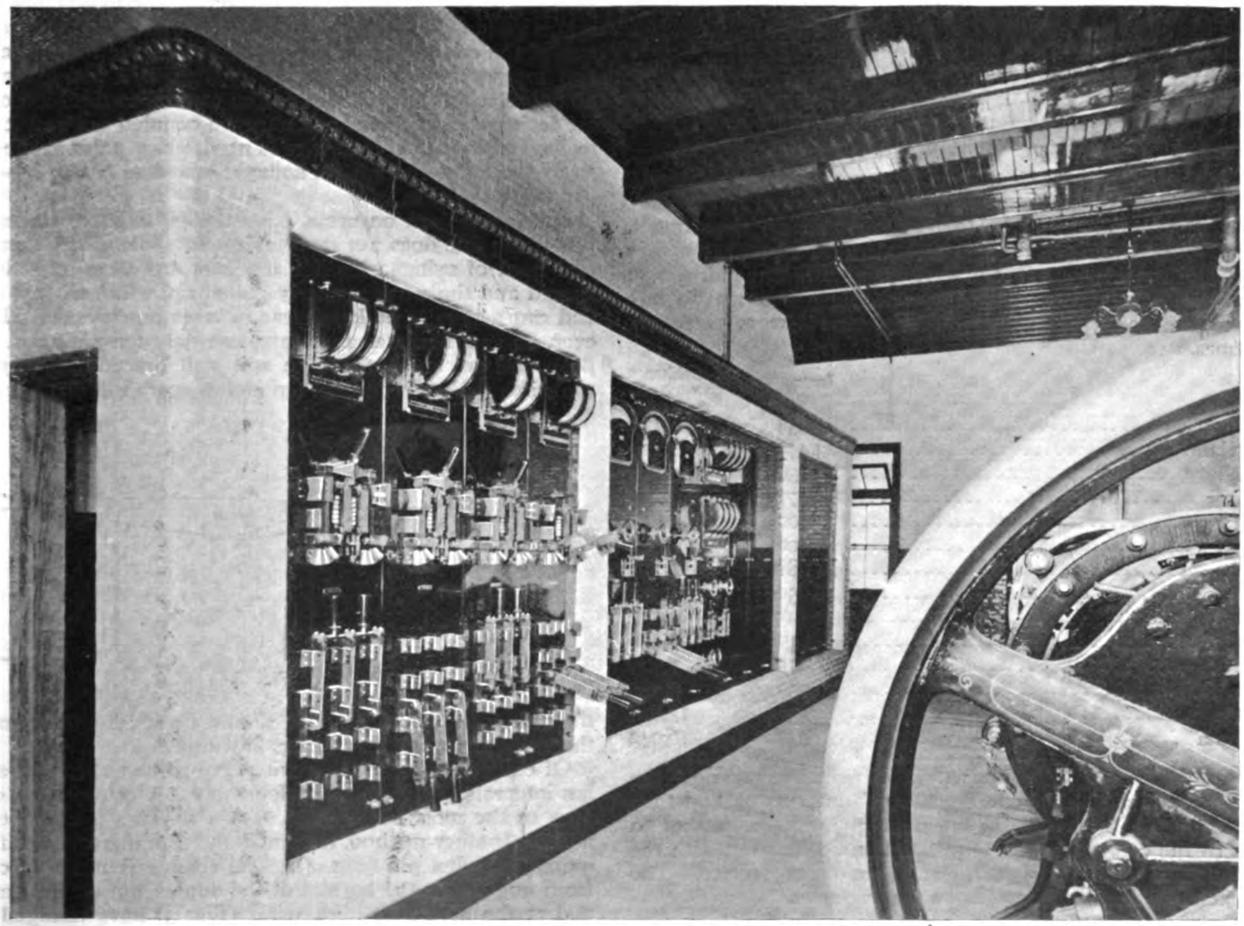


FIG. 4.—SWITCHBOARD, BOSTON CITY HOSPITAL.

stalled in the past two years by the Electrical Construction Division:

Deer Island House of Correction.—New power house designed for an ultimate capacity of 500 ... p. At present there are installed one 120 h. p. Campbell & Zell water tube boiler and one 100 h. p. McEwen engine direct connected to 75 k. w. Thomson-Ryan generator.

Chestnut Hill Pumping Station.—350 incandescents and 4 arcs. One 40 h. p. vertical marine type General Electric engine, direct connected to a 25 k. w. General Electric dynamo.

Public Buildings Department Repair Shop.—200 lights and 30 h. p. of motors. One 60 h. p. "Ideal" engine direct-connected to a 40 k. w. Thomson-Ryan generator. This is a 220-volt plant.

The Sewer Department Pumping Station, Old Harbor Point.—100 incandescents and 30 arcs.

The following harbor boats and tugs belonging to the city have also been equipped with electric lighting plants by the Electrical Construction Division:

Police and Harbor Master's tug.

Ferryboats "Gen. Hancock," "East Boston," "Winthrop," "Revere," "E. D. Kelly" and "William E. Russell."

In addition to the above the following plants were installed by contract some years ago:

Boston Public Library, 3,000 lights, consisting of two 100 k. w. and one 40 k. w. Siemens & Halske generators direct-connected to Lake Erie engines.

Long Island Alms House, 950 lights and 40 h. p. of motors, consisting of three Westinghouse engines belted to three 12 k. w. C & C generators.

Marine Park, South Boston, 200 lights and 5 h. p. motors. One Westinghouse engine direct-connected to 15 k. w. Westinghouse generator.

Fire Department Headquarters, 200 lights and connections to fire alarm generators. General Electric Marine engine and generator.

Up to the present time very little data has been obtainable regarding the cost of operation of these plants, but it is intended in the future that the Electrical Construction Division shall keep records with regard to this, and also make frequent examinations of all the plants and supervise their operation, reporting their condition to the departments to which they belong.

In conclusion, thanks are due to Mr. Cottle and also to Mr. Hatch for their courtesy in supplying the information regarding the above work.

Recent Telephone Statistics From Europe.

Mr. J. C. Monaghan, Consul at Chemnitz, Germany, sends to the State Department the following compilation of recent telephone statistics in Europe. He remarks: In no department of industry is Germany more active than in electrical appliances. The list leaves out Norway, Denmark, Finland, Great Britain, and Portugal, because these people put down no answers to the cards of inquiry; Turkey and Greece have no telephones.

Country.	Instrument.	Inhabitants to each telephone.
Sweden	42,354	115
Switzerland	23,446	129
Luxemburg	1,356	160
Germany	131,577	397
Holland	7,900	615
Belgium	9,400	682
France	31,681	1,216
Austria	18,950	1,318
Spain	10,810	1,597
Hungary	8,458	2,168
Italy	11,815	2,629
Russia	16,050	6,988
Bulgaria	243	13,616
Roumania	337	16,042

WOODSTOCK, ILL. Mr. A. B. Wager, manager of the "Woodstock Local Telephone Exchange," informs us that they have 70 miles of metallic toll line and give service second to none. In the county they have five stations competing with the Bell and nine stations where there is no other service. The local exchange has no fewer than 84 subscribers.

MR. W. CARSE writes us: I would not miss having The Engineer for anything. I think it is the best journal I get.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—III.

BY A. E. DOBBS.

COUNTRY AND TOLL LINES.

LINES more than twelve miles in length should be metallic circuits, and even the shorter lines will give better results if metallic. But sometimes the revenues will not justify the expense of stringing two wires, but this is a matter that must be governed by circumstances. There are parts of the country where grounded lines will work fairly well, even as far as a hundred miles; but a trolley line within five miles will affect them, and one within two miles will make metallic circuits necessary for satisfactory service, especially if the two run parallel. Wire used in this class of work should not be smaller than No. 12 B.

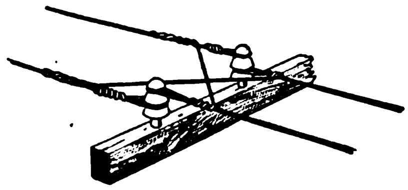


Fig. 3.

Fig. 4.

W. G. iron, or No. 12 B. & S. copper. For longer lines No. 9 iron is good up to fifty miles, though No. 12 copper is better. The size of the conductors should be such that the resistance of the two longest toll lines coupled together will not exceed 4,000 ohms. But the lines should not be worked to the limit of highest resistance, as extensions must be counted on, and it is well to have enough. If iron wire is used, place poles at the rate of 33 to the mile—though we sometimes see as few as 25—if copper, 40 to the mile.

If the wires are on arms, have the pins twelve inches apart. But if the line does not carry more than four wires, there is no real need of using arms, for brackets are cheaper, and if well spaced and the wires properly pulled up, will look just as well, and can generally be kept clear of trees much easier. If, however, an arm becomes necessary, use only ten-pin arms. If the poles are set 40 to the mile and well braced and guyed and the wires pulled tight, pins ten inches apart will do; but be sure

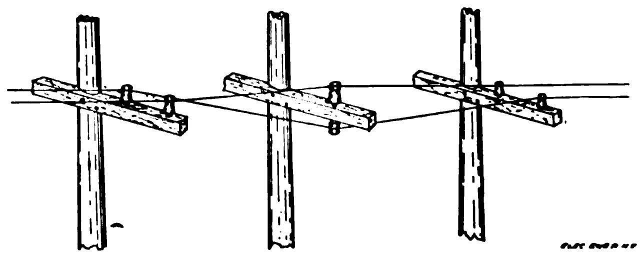


Fig. 5.

the arm is heavy enough. It should be at least three inches in thickness and a full four inches in width.

Of course, all metallic circuits have to be transposed at regular intervals. There are various ways of transposing circuits. One of the most common is shown in Fig. 3, which explains itself. Another method, known as the running transposition, requires a duplex pin (Fig. 4). The change is made by crossing from one pin to the bottom of the duplex pin on the next arm, and at the next pole both wires (Fig. 5) have changed places. This system saves making joints, but is troublesome.

The necessity for proper transposition of long metallic circuits

is well known, but just how to do it has caused a great deal of hard thinking and it sometimes keeps the best of telephone men guessing where they are at. While it is possible to map out a plan of transpositions before the line is built, still, changes are often necessary and a brief study of the principles involved will help in understanding the matter. It is pretty well understood that two or more wires running side by side for a long distance will have an effect upon each other when traversed by an alternating current and that the induced current in its neighbor has a direction opposite its own.

If we pass a current through a wire, a cross-section of which is shown in Fig. 6, and test it with a dipping needle, we find lines of force radiating from it in all directions, as shown by the dotted lines. We also see that another closed circuit nearby, at say the point A, will attract the larger number of them to one side and the nearer these two circuits are together the greater tne number of lines attracted, and that a magnet or piece of iron at A will deflect still more of them.

Turning to Fig. 7, we have shown two circuits running side by side and both in use. Supposing that both are connected to the board the same way—as they are likely to be—and that they are also connected to the same side of the battery, we have then the +, or positive side of our circuit, on the first wire, and the —, or negative, on the second. By following the direction of the arrows between the first and second circuits we find an exchange of the magnetic lines turning in the same direction as the current on the next wire between the points A and B. Now, if kept up, this would induce a condition of unbalance, and even if it did not throw in cross talk would make the lines noisy.

If now we transpose one of the circuits at B, we still find an exchange of the lines of force, but this time they are opposing, and if equal, will neutralize each other. If both circuits were transposed at B the effect would be the same as it would be from A to B, only the induction would come from opposite sides, but by transposing one circuit at B and another at C it will be seen that half the time the currents pull together and half the time oppose each other, so that if regularly transposed the effect is nil. Circuits could not be arranged to oppose one another all the time because the current is changed with the direction of the conversation, but even if it were possible to keep them opposed all the time, their effects would be to retard each other, increase the resistance of the line and throw it out of balance. Then, too, there are the induction from the earth and other electric circuits to be considered, so that even if their mutual induction were done away with or suppressed it would still be necessary to turn the circuit over, in order to present different sides to the source of the disturbance. Then there is the mutual induction between the two sides of the circuit itself, and were it not for an occasional transposition that, of itself, would upset the balance. The more the lines of force or induction can be induced to stray to its mate, however, the less there is to stray away elsewhere, and Fig. 10 shows the design of an arm intended to keep the two sides of the circuit as close together as possible, the pairs being only six inches apart, while the distance to the next circuit is fourteen inches. As the longest line is in the center, there is no need of having the wires so close, and they cannot be, on account of the pole space. But the looks of this arm will probably prevent its adoption, and, besides when wires are only six inches apart, they have to be pulled up well, and even, to keep clear of trouble.

This brings up an hypothesis held by the writer for some time, which is, that a circuit partly of iron, or steel, and partly of copper, or aluminum, will give better results than one wholly of copper. In Fig. 8, let us suppose that of the circuits 1 and 2 the two heavy lines, representing iron wire, are placed on the outside, while the two center ones are copper. Does it not seem reasonable to suppose that these iron wires would, to a certain extent, act as a shield against outside influences? Also that the magnetic quality of the iron would draw the lines of induction from its mate, instead of permitting them to stray to outside sources? It is pretty well known that a certain amount of self-induction is a good thing with which to oppose the static charge, for, while the magnetic induction travels with the current, the static charge opposes it, and by transposing at regular intervals the resistance of the circuit is kept in perfect balance.

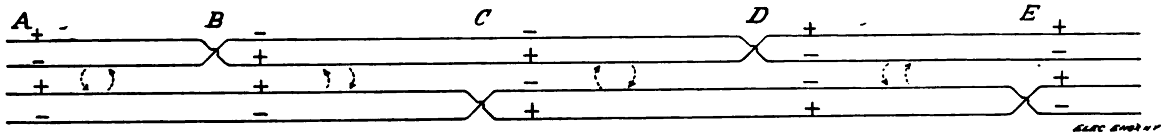


Fig. 7.

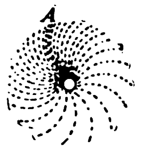


Fig. 6.

Fig. 8.

Between the two towns of Kent and Ravenna, O., there is such a line, one being No. 12 steel and the other No. 12 copper. The line is as quiet as could be desired, though, as it is only seven miles in length, it cannot be regarded as a fair test, especially as lines in that section from 30 to 50 miles in length are commonly built with No. 9 iron, or steel, and the service on most of them leaves nothing to be desired.

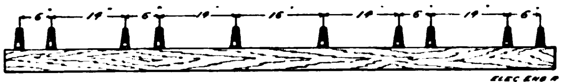


Fig. 10.

In quiet country sections, lines are transposed at intervals of a mile, but near telegraph or trolley lines this has to be increased. The only way to test it is to go on the line with a telephone and keep cutting in transpositions till the line gets quiet. In some places it may be necessary to transpose every five or six poles.

In Fig. 9 is a map of transpositions similar to that used by the American Bell Company in their long-distance work on ten-pin arms. The longer lines will not require such frequent changes as the shorter ones. Divide the line into sections of a quarter of a mile each, as shown by the letters A, B, C, D. Transpose the middle line on A and for the lines adjacent half way between, say one at C and the other at D, and, as the outside lines will probably be shorter ones, transpose twice as often, say at A, C and B, D, making these come half a mile apart. Then as each line is built, test it with a telephone and if noisy try to locate the disturbance. It may be a trolley line at one end. That being the case, cut in a few more changes at that end. When more than one office is connected to a toll line—and there generally is—bridging bells in multiple are the only kind that can be relied upon, for a 1,000-ohm bell, on account of its high resistance and high self induction, will permit of very little leak from the radily alternating currents (100 to 2,000 per second) found in telephonic conversation. In a transformer for electric lighting very little current is lost when there is no load on, because the self induction of the core gives back to the line 95 per cent. of the current put into it, and it is probable that a 1,000-ohm bell will do equally as well as ten or twelve instruments sometimes put on a line. Never use series telephones for this kind of work, as the self induction of an 80-ohm bell will increase its resistance many times beyond 80 ohms.

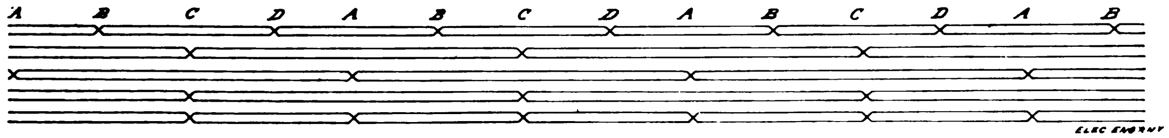


Fig. 9.

POWER TRANSMISSION

The Harnessing of the Missouri River Near Helena, Montana.

SO numerous have been the water-power installations in the far West and on so large a scale have they been inaugurated, that the East has often stood aghast at the evidence of Western enterprise and development. The contour of the land, the abundance of falls and the springing up of large industries have all been leading factors in making possible these power enterprises. This utilization has now been recognized as a necessity by the communities which vie with each other for commercial and industrial supremacy. This natural and wholesome competition has in turn brought about a development of hydraulic and electrical machinery without which the successes of the Western power plants could not have been achieved. The latest and only partially completed water power installation of the Rocky Mountain region is the one in course of construction eighteen miles from Helena, Montana. Here it has been proposed to harness the water of the Missouri river, flowing peacefully past the picturesque mountain ranges, as may be seen in Fig. 1. A timber dam, shown in Figs. 2 and 3, was constructed, giving a 27 ft. head. At one end of this dam a heavy stone embankment was built, shown in the two illustrations just mentioned, and within this structure the penstocks are imbedded as shown in Fig. 4. The penstocks enter the power house at the side facing the cliffs, and in order to accomplish this, very sharp turns had to be made, as shown in Fig. 5. The power house, which is only partially completed, is built entirely of stone and iron. A plan of the power house, showing the present installation of apparatus, as well as the penstocks, and indicating the contemplated addition is shown in Fig. 6. A vertical section of the power house, showing the penstocks entering the building, their connection to the waterwheels and the connection of these to the generators, the tail-race and other details, are shown in Fig. 7. The location of the turbines and their regulators may also be seen in Fig. 8. The hydraulic equipment consists of four pairs of 42-inch New American turbines and two single 25-inch

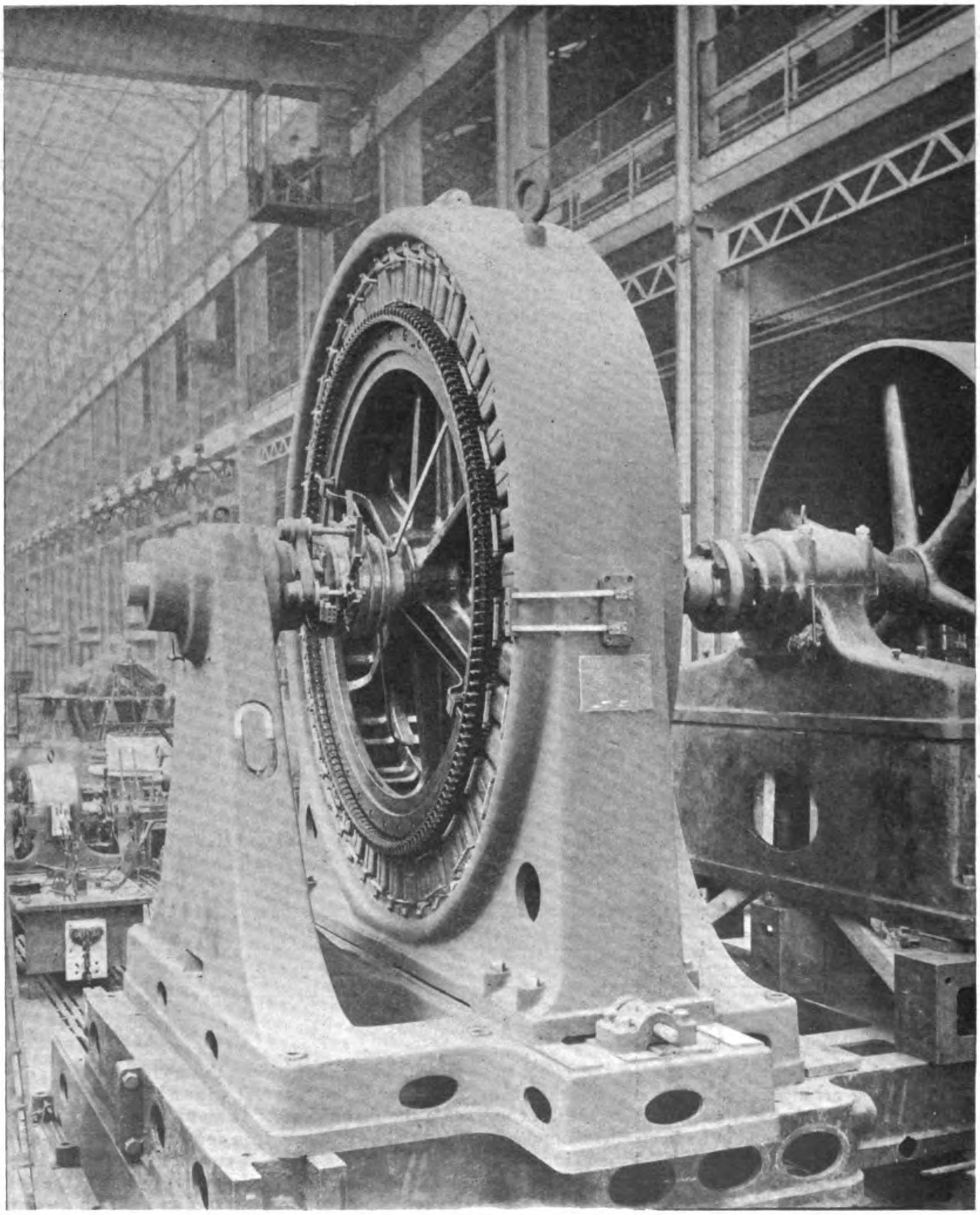


FIG. 9.—650 K. W. 2-PHASE WESTINGHOUSE GENERATOR FOR HELENA, MONTANA.

New American turbines, all constructed by the Dayton Globe Iron Works Company, of Dayton, Ohio. Each pair of the large turbines is of 1,000 h. p .capacity, and the 25-inch turbines are of 100 h. p. capacity and each drives one exciter. The entire

FIG. 1.—BIRD'S EYE VIEW OF THE MISSOURI RIVER AND THE SURROUNDING COUNTRY.

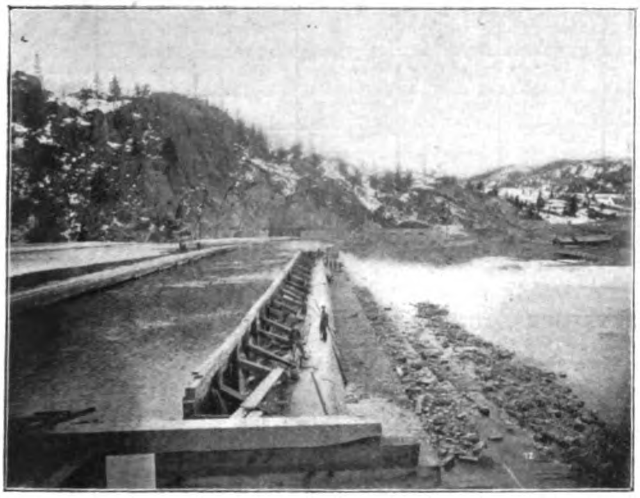


FIG. 2.—CONSTRUCTION OF OVERFLOW; POWER HOUSE IN THE DISTANCE.

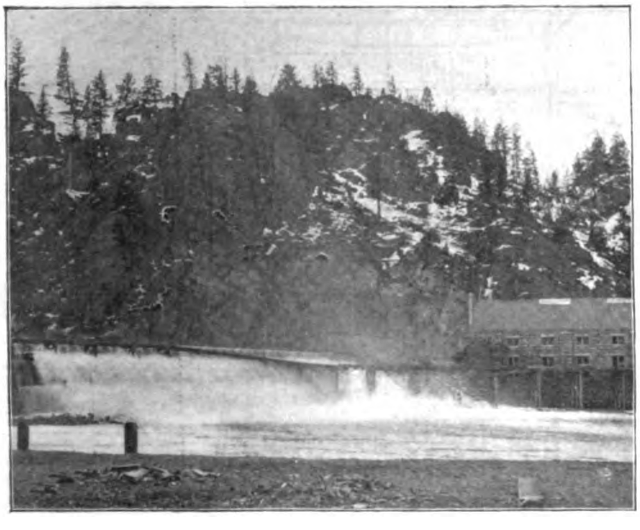


FIG. 3.—VIEW SHOWING POWER HOUSE AND OVERFLOW.

electrical equipment was installed by the Westinghouse Electric and Manufacturing Company and consists at present of four 650 kilowatt direct-connected generators shown in Fig. 9, generating current at a pressure of 500 volts. Four additional units will soon be installed. The low pressure switchboard in the power house indicated in Fig. 6 permits the running of the generators separately or in multiple. From this board the cir-

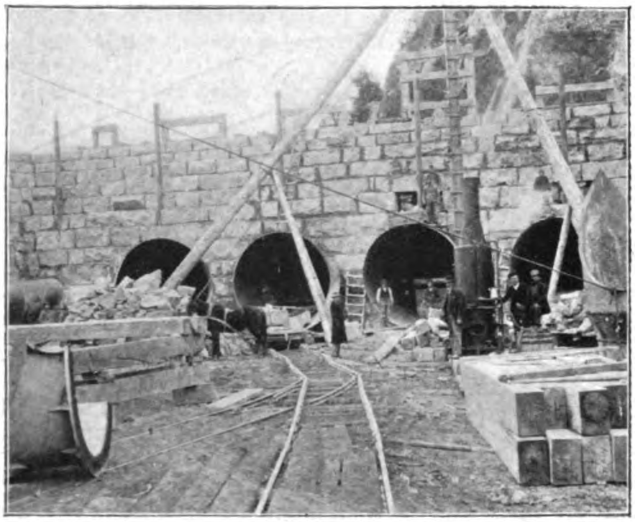


FIG. 4.—END OF ABUTMENT,SHOWING PEN STOCKS ENTERING THE SAME.

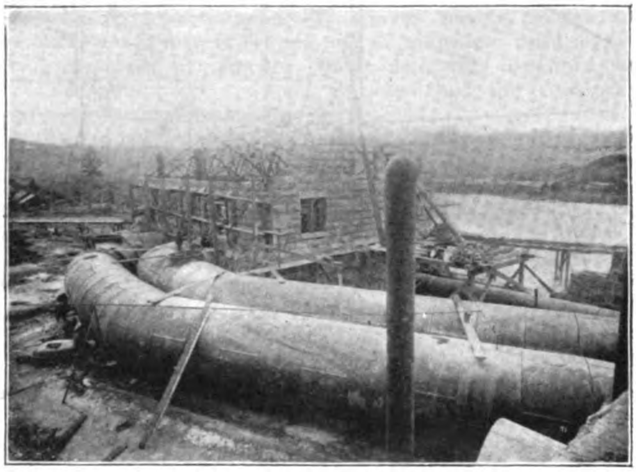


FIG. 5.—EXTERIOR OF POWER HOUSE, SHOWING PENSTOCKS ENTERING THE SAME.

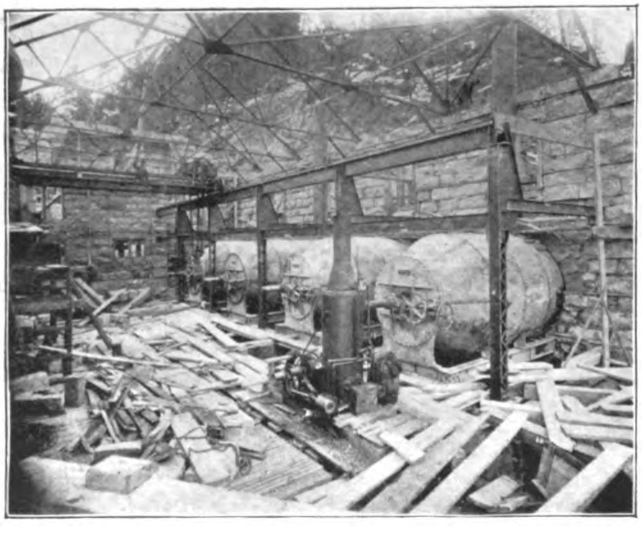


FIG. 8.—INTERIOR OF POWER HOUSE, SHOWING LOCATION OF TURBINES AND GOVERNORS.

cuits are run to the converter house about 100 feet away from the main power house. This contains eight 325 kilowatt static step-up transformers, raising to 10,000 volts, three-phase for line

transmission. There are at present four lines, consisting of No. 4 bare copper wire, supported on Imperial and Thomas insulators, running as far as East Helena, a distance of eleven miles; from there to Helena two lines are continued. A high potential switchboard at East Helena permits the running of the lines separately or in multiple, and the cutting out of any one of the lines between the power house and East Helena, in case of trouble.

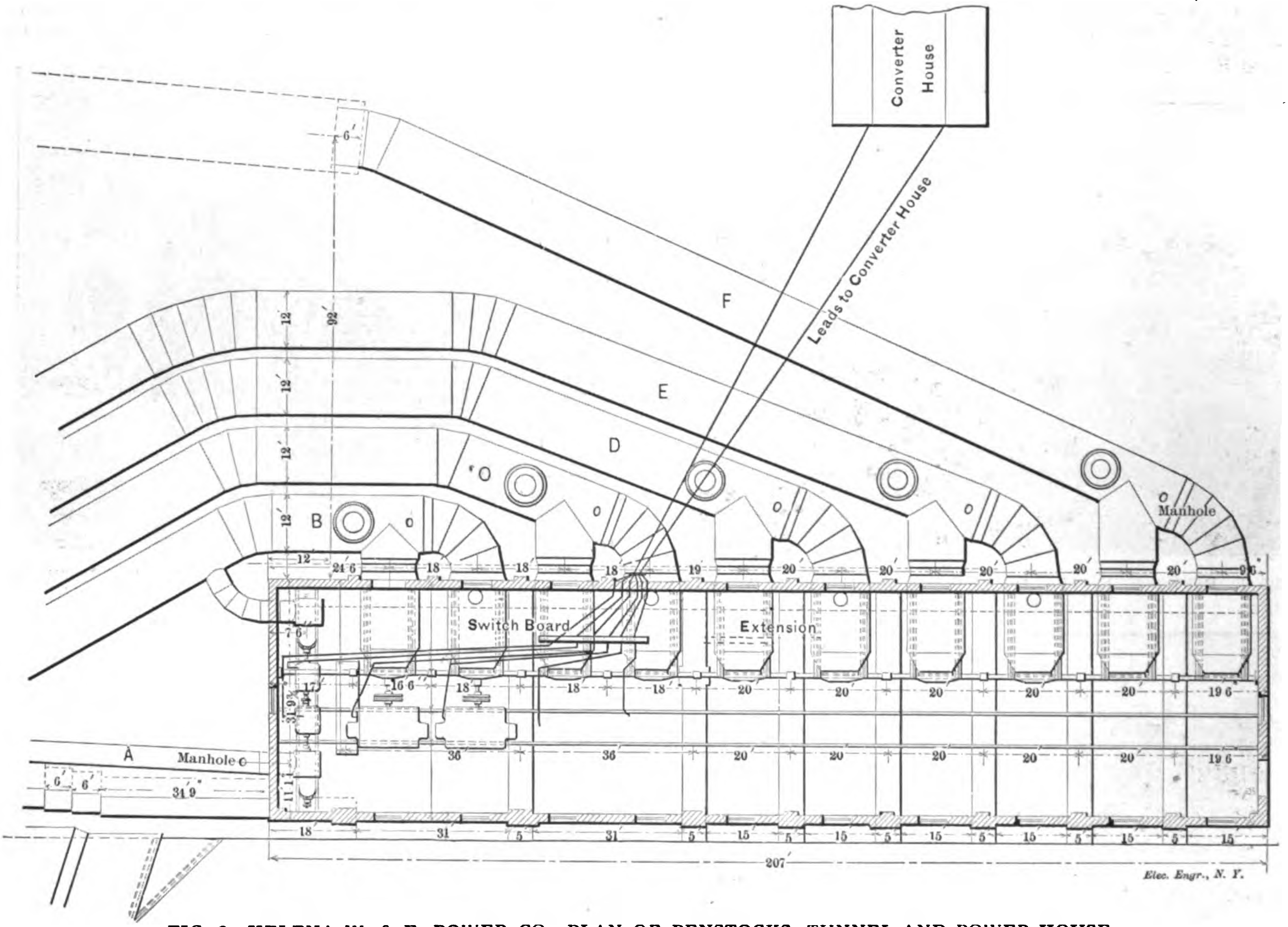


FIG. 6.—HELENA W. & E. POWER CO., PLAN OF PENSTOCKS, TUNNEL AND POWER HOUSE.

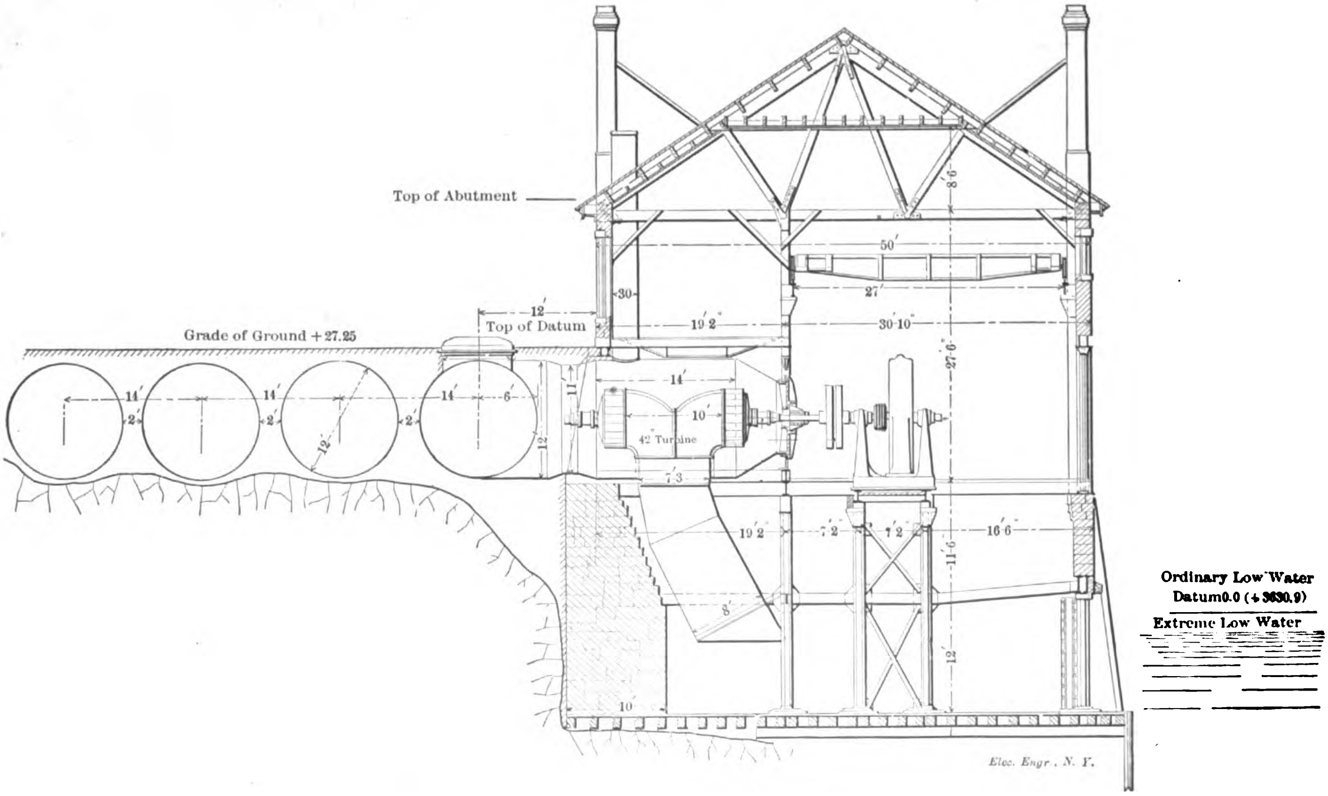


FIG. 7.—HELENA W. & E. POWER CO., CROSS SECTION OF POWER HOUSE.

Although the plant is only being installed at the present time, the company have already secured the following customers whom they will supply with current: In East Helena, the Helena and Livingston Smelting and Reduction Company, who have an equipment of two 500 h. p. and two 15 h. p. Westinghouse motors. One mile beyond tnis point the United Smelting and Refining Company use two 175 h. p., three 100 h. p., one 30 h. p. and one 20 h. p. induction motors. These operate blowers, crushers, pumps and hoists.

Two lines running to Helena supply the Helena Power and Light Company, which operates the local railway and lighting system, with power. Three 150 kilowatt transformers are installed for lighting purposes, using transmitted power directly. There are also installed three 100 kilowatt transformers, arranged in delta connections, operating two 175 kilowatt rotary

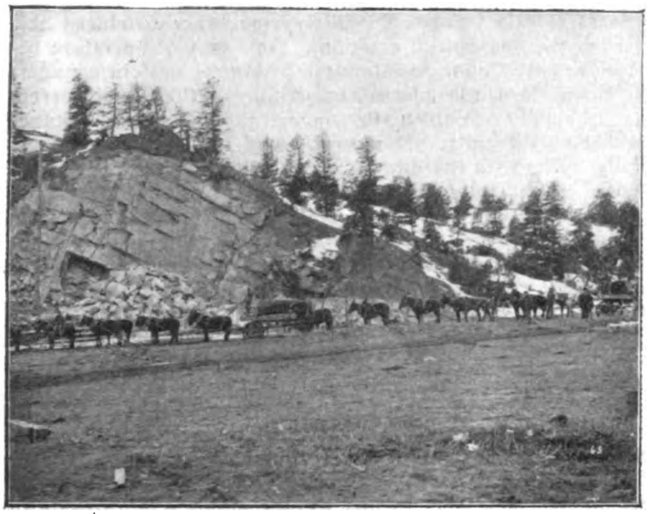


FIG. 10.—TRAIN OF MULES CONVEYING PARTS OF GENERATORS TO POWER HOUSE.

transformers for railway supply, three 50 kilowatt transformers, in delta, operating two 100 kilowatt synchronous motors, which drive arc machines for street lighting. Probably one of the transmission circuits will be used exclusively for the lighting, the other for the motor load to give good regulation.

Much engineering skill was exhibited in the design and construction of this plant, which was attended by many serious obstacles and difficulties. The apparatus had to be hauled for many miles over mountain roads, as shown in Fig. 10, and a great deal of preliminary work had to be done before the dam and power house could be erected.

Much credit for the successful carrying out of this enterprise is due to Mr. J. T. Fanning, of Minneapolis, who was the consulting hydraulic engineer; J. G. White & Company, New York, the consulting electrical engineers; Mr. B. Sewell, of Chicago, the general manager, and Mr. C. W. Whitley, the superintendent of construction. It may be stated that the heaviest stockholders in the company constructing this plant are New York financiers, who form the Smelting Company mentioned above.

Considerations Governing the Design of the Crocker-Wheeler Direct-Connected Motors.—I.

BY GANO S. DUNN, Chief Engineer.

THE speeds of electric motors are no longer a result of the necessities of design, but, owing to the progress of engineering knowledge, may be fixed at whatever value is most convenient for the intended work. Instead of the rapidly revolving armatures of the early period, requiring at least one, and often two or three, reductions of speed, by belt or gearing, we can now make, without prohibitive cost, armatures whose speeds are identical with those of the shafts they drive, and which may therefore be mounted directly upon them; which does away with the belting, countershafts, bearings, etc., upon which old-time practice had to rely.

As the power of a motor is equal to its torque, or turning effort, multiplied by the number of turns it actually makes per minute, it follows that to give an equal output, a motor which runs at two hundred revolutions will have to develop five times the turning power of one which runs at one thousand revolutions. This means it must be nearly that much larger and more expensive; and, moreover, the increased size involves increased electrical losses, which reduce the efficiency. How to get the output without too great an increase of size and accompanying cost and waste of electrical energy was the problem which the engineers of the Crocker-Wheeler Electric Company set before themselves.

These ends have been secured, first, by maintaining a high

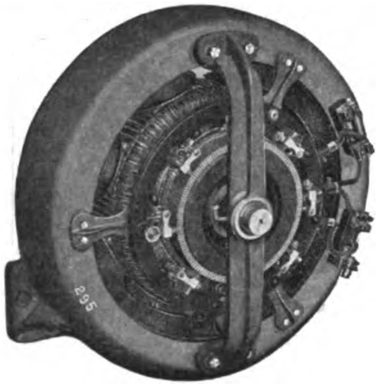


FIG. 1.—CROCKER-WHEELER SIZE 1-100 DIRECT MOTOR, WITH BEARINGS AND PLAIN FEET.

activity of material, by the employment of many poles, and the large diameter armature, which gives peripheral speed high in proportion to the revolutions per minute; second, by selecting a construction involving a minimum of labor, and third, by preferring the forms of magnetic circuit, field coils, armature core, etc., that involve not only the apparent, but the theoretical, minima of the various losses.

While the last considerations are sometimes at variance with those which secure a minimum of labor, preference in these cases has been given to efficiency, even if it involved a more expensive construction.

A gain in efficiency means a never-ceasing economy that soon pays for a moderate increase of first cost, and contributes to the excellence of the machine's performance by permitting

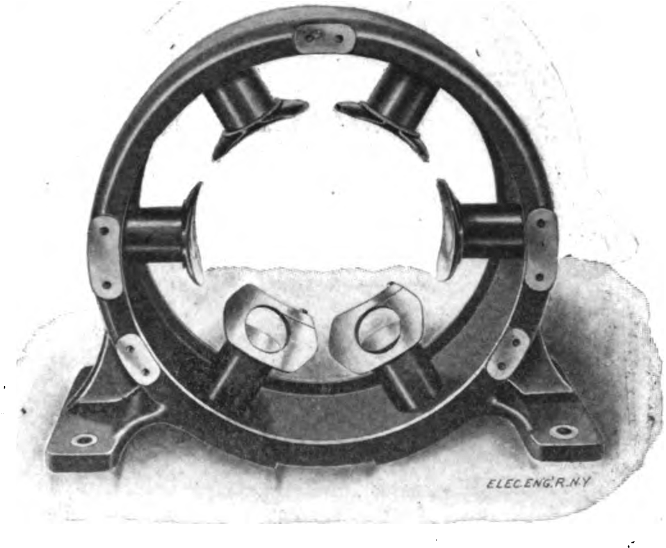


FIG. 2.—MAGNET FRAME SHOWING METHOD OF FASTENING ON THE POLE SHOES.

cooler running, greater steadiness of speed, and other desirable features.

The typical construction adopted, after careful study to secure these ends, is shown in the engraving Fig. 1.

The field is formed of a plain cast-iron ring into which are cast-welded eight, and in the two smaller sizes six, round wrought iron poles. These poles are supplied with removable shoes clamped in place by an ordinary bolt after the field coils have been slipped into position, as shown in Fig. 2. The shoes reduce the density of the magnetic flux where it enters the armature and permit thereby a long air gap which is of great value mechanically, and they also hold the coils securely. By

taking off the shoes, the coils may be interchanged for altering speed, for adapting the machine to another voltage, or for repairs.

The use of a field of many poles, each excited by a coil, greatly reduces the weight of iron in the machine, and, although in-

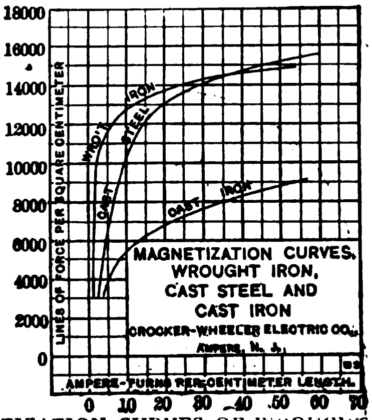


FIG. 3.—MAGNETIZATION CURVES OF WROUGHT IRON, CAST STEEL AND CAST IRON.

volving some increase in the copper and considerable additional labor, gives a motor which is easy to handle and very short in the dimension parallel to the shaft, a feature of much importance in printing press work. But these are not the only advantages, for this type is that of the maximum obtainable efficiency, as can be easily demonstrated.

Steel is so perfectly manufactured at present that it leaves little to be desired as regards magnetic permeability, but it is nevertheless excelled by wrought iron at all points except those of the higher saturations, as shown in Fig. 3. As, in machines of the low-speed type, we are compelled to work at low saturations for purposes of regulation, and to minimize the comparatively large losses, we can by using wrought iron employ a diameter of pole considerably smaller than with steel, and, as a re-

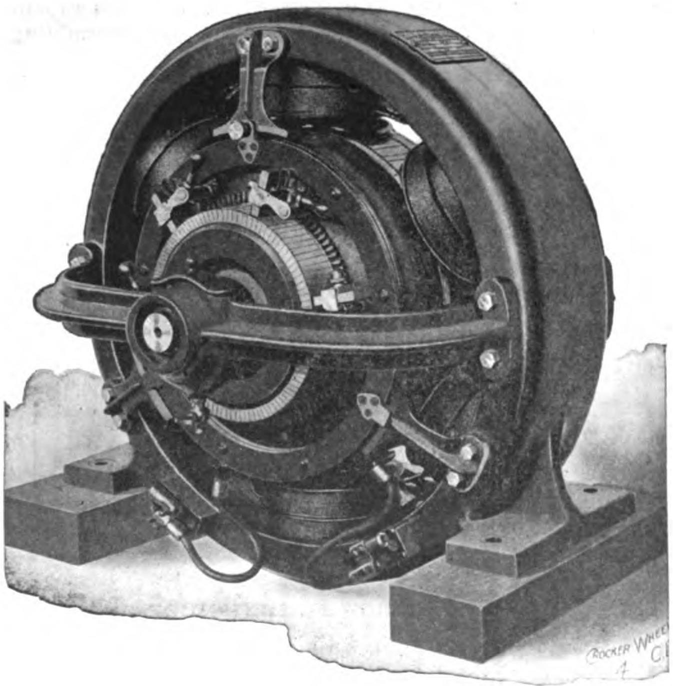


FIG. 4.—CROCKER-WHEELER, SIZE 2-100 MOTOR, FOR DIRECT CONNECTION TO MACHINE.

sult of the saving of field winding, make another gain in the machine's efficiency.

In addition to the foregoing characteristics which affect the efficiency of the type of field adopted, its form has been designed with a view to ready attachment to machinery in the most trying positions, and a shape has been selected which, while giving a pleasing appearance of solidity, will also protect the field coils by semi-inclosing them under a protecting flange that serves also as the web of a girder in strengthening the ring against collapse.

A glance at Fig. 4 will show how this shield serves to receive all sorts of attaching lugs for support of the motor wherever it is not desired to have it rest on its own feet on the floor. It will be noted that the form of field adopted is open and gives access of air to the coils, keeping them cool; and yet the fields are protected from damage by the shield.

Successful Monocyclic Power Distribution at Middletown, Ohio.

THE number of central stations using that modification of the single phase system, known as the monocyclic, by which current may be supplied to both lamps and motors at the same time from their alternating generators, has within the past two years greatly increased. This system was introduced at a time when the question of extending their area of operation began to force itself upon the attention of central station managers using either the single phase, alternating, or the direct current system of supply. With the first named the question of distance presented no difficulty, but motors could not be operated successfully by it; with the direct current system, while the motors presented no difficulty, the area of operation was limited. With the newer system it was found that both arc and incandescent lamps, as well as induction motors, could be supplied from the same alternator, the first named operating directly from the ordinary two-wire single phase circuits, the motors merely requiring a third wire to give a displaced voltage. Operation of the monocyclic system has evidently proved satisfactory, as the present installations are quite numerous.

An interesting example of the introduction of the monocyclic system into a direct current station, allowing the area of its operation to take a wide extension, exists at Middletown, O., where Mr. E. F. McKnight, the president and general manager of the Midletown Electric Light and Power Company, has recently found it necessary to increase the monocyclic capacity of his plant to meet the increased call upon his station. In addition to the arc and incandescent lighting usual in towns of the size of Middletown, certain factories under progressive managers have adopted electricity in place of steam, and the motor load on the station already far exceeds the lighting load.

The station fronts on the Miami and Erie canal, having the tracks of the M. & C. railroad immediately behind it. It is 65 feet wide and 115 feet long. Steam is supplied from two Brownell

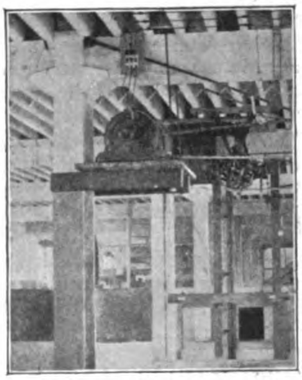


FIG. 2.—MOTOR IN ASSEMBLY ROOM OF THE MIAMI CYCLE AND MANUFACTURING CO.

& Company Dayton boilers, to one 450 h. p. compound condensing Buckeye engine and one 300 h. p. four-valve Russell condensing engine. The generating plant, shown in Fig. 1, consists of two General Electric 12-pole, 150-kilowatt, 1,040-volt, 600-revolution monocyclic generators, excited by two 1½ k. w. exciters; three 50-light Thomson-Houston series arc dynamos and one General Electric 100 h. p. 500-volt direct current generator, all driven from countershafting furnished with the necessary friction clutches.

The 500-volt machine is used exclusively to furnish direct current to several small motor plants throughout the city; the arc machines operate 112 city arc lamps. The motor load on the monocyclic machines runs up to within a short limit of their capacity. The factory of the Miami Cycle and Manufacturing Company, a little over a mile away from the station, takes 200 h. p. when its motors are running at their rated capacity, and

considerably in excess of this under usual working conditions. This company manufactures the well-known Racycle, and hundreds of these wheels are built weekly, giving employment to 600 hands. The current is received in the factory in six 40 h. p., one 20 h. p. and two 10 h. p. transformers, reducing the pressure to 115 volts. The motor circuits run from the 40 h. p. transformers, the lighting circuits from the three of smaller capacity, and all the current is measured in a recording wattmeter, connected on the primary circuit. The motor equipment consists in all of ten General Electric induction motors—three of 20 h. p. in the machine shop, driving 88 machines; one of 10 h. p. in the drill and pattern room, shown in Fig. 2, driving 29 machines; another of 10 h. p. driving the machinery in the frame department; three of 30 h. p. in the polishing room, two for the polishers and one for the 48-inch exhaust fan; one of 5 h. p. driving two plating dynamos in the plating room, and another of similar capacity operating a number of small machines in the assembling room, as well as a three-ton elevator. The incandescent lights in the factory number 750, of which, during the rush season almost all are lighted.

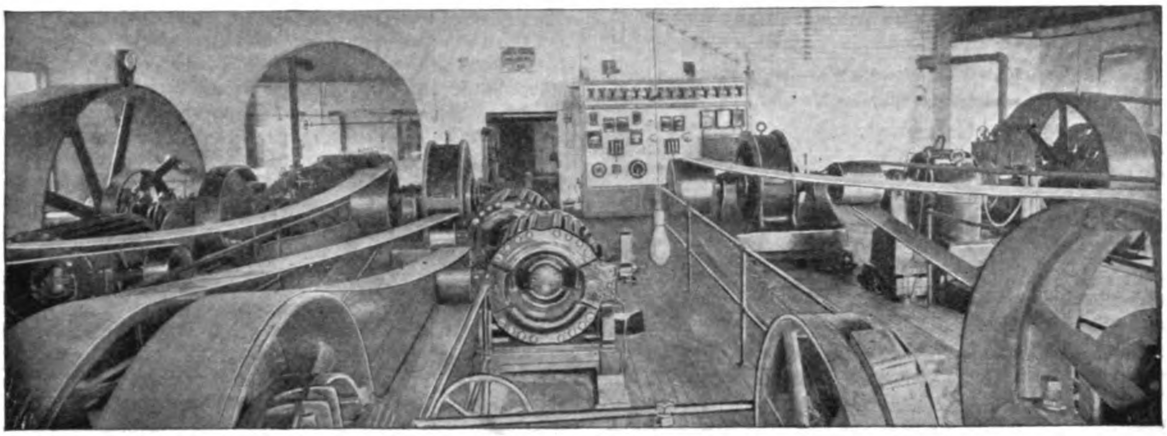


FIG. 1.—INTERIOR OF MIDDLETOWN, OHIO, STATION, G. E. MONOCYCLIC EQUIPMENT.

In addition to the cycle factory, Mr. McKnight furnishes power to the tobacco factory of the P. J. Sorg Company, in which two departments are already equipped, each with a General Electric 30 h. p. induction motor. One of these is the smoking tobacco department, on the first floor, and is belted to shafting, operating, on the three floors above, three Caldwell pickers, one cutter, two granulators and two dust machines. The second motor is on the sixth floor (Fig. 3), and is shown with the transformer and the meter to which the primaries from the station are connected. From this point secondaries are carried to motor No. 1 in the smoking tobacco department, distant about 500 feet, and the lights in the different departments being tapped off before the motor is reached. Motor No. 2 drives two 7½-inch Sturtevant fans, used to dry all the tobacco. It also operates a five-ton elevator. The capacity of the drying department is 100,000 lbs. of tobacco daily.

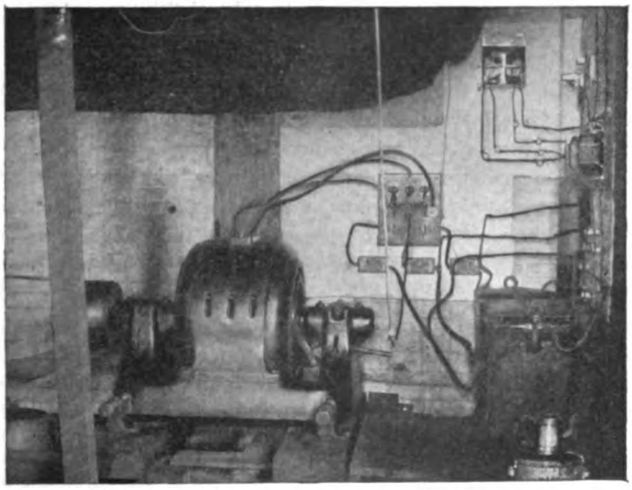


FIG. 3.—MOTOR AND TRANSFORMER IN THE FACTORY OF THE P. J. SORG CO.

The benefits of electric drive by induction motors are, perhaps, nowhere so forcibly demonstrated as in these two installations. In the cycle factory the constant speed of the machinery, the absence of vibration and the power of the motors to respond to calls reaching as high as 50 per cent. over their rated capacity, have enabled the manufacturers to give to every part of their wheels a perfect finish, as well as to greatly increase the output. In the tobacco factory the steady rate at which the tobacco passes through the dryers gives it a uniform cure. Previously, the speed being variable, the tobacco would dry in spots only, and a second handling was almost always necessary. According to the foreman, the motor "saves him lots of time."

The incandescent lights in the town already wired number 3,800; of these 750 are in the cycle factory, 100 are in the tobacco factory, 650 are in the opera house and 2,300 in other parts of the town. These lamps burn with absolutely no interference from change in the motor load; in fact, the entire motor load may be thrown on or off without in the least affecting the burning of the lamps, the presence of the motor load being usually only determined by reference to the ammeter. The monocyclic machines operate with almost perfect regulation, requiring little or no attention to maintain the constant potential at all times.

A Novel Advertising Candle.

Among the odd trade advertisements displayed at the recent Stockholm exhibition, the Lilietolmens candle played a prominent part. This candle stood no less than 127 feet high. The lower part, which was intended to represent an old Swedish candlestick, was in reality an enormous structure of bricks and mortar, in which was established a perfectly equipped candle factory, where employés worked six hours a day. The base of the candlestick covered a space 40 feet square. To come to details, the candlestick itself was 47 feet high, while the candle—a real stearine specimen—was fully 80 feet; its diameter was 8½ feet. The appearance of this extraordinary trade trophy was at once remarkable and imposing. The colossal candlestick was painted with an aluminum powder until it shone like well polished silver. At night, too, an electric searchlight of 7,000 (ordinary) candle-power cast its beams from the lofty summit of the wick over the whole of the exhibition grounds. Altogether, the cost of the monster was about $10,000.

PRINCE ALBERT LEOPOLD, of Belgium, who is now visiting this country, announces that one of his chief objects is to study our electrical work. He is 23 years of age, son of the Count of Flanders, and nephew of King Leopold, whom he is likely to succeed.

KANSAS CITY, MO.—The power plant of the Northeast Electric Railway Co. is being enlarged.

MR. H. A. HUBBELL, in renewing his subscription, says: I read The Engineer with very great interest.

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Aluminum Versus Copper for Electrical Conductors.

NO one will deny that the progress of the electrical engineering industry has always been marked by a decided tendency to substitute, regardless of former usage or custom, the simpler for the complex, the cheaper for the more expensive; and the more economical for the less efficient. The rapid introduction of alternating high potential currents, induction motors, enclosed arc lamps, and the substitution of copper wire for iron in telegraphic and telephonic work have been ample proof of the above assertion. Naturally the item which represents the largest investment in any industry or a portion thereof deserves and receives the most careful consideration, as a reduction in cost or a simplification means the saving of large sums of money and less liability of accidents.

The wide distribution of aluminum in nature and the cheapening of the processes for its reduction has brought that metal prominently before the public. The electrical engineer is particularly interested in the use of aluminum for electrical conductors on account of its light weight, low cost and ability to resist corrosion. The thought to substitute it for copper soon suggested itself and arguments pro and con the use of the two metals arose and are still going on. The latest opinions on the subject are those of Capt. Alfred E. Hunt, president of the Pittsburg Reduction Company, which we published in full in our issue of February 24, 1898, and those of Messrs. H. G. Field, Alexander Dow and others who participated in a discussion of "Notes on Aluminum," a lecture delivered by Mr. Jesse M. Smith before the Detroit section of the Association of Engineering Societies. Capt. Hunt, after a thorough comparison of the properties and cost of copper and aluminum, reaches the conclusion that as to their relative cost for electrical conductors of equal conductivity, aluminum at 29 cents per pound is the more economical conductor as compared with copper at 14 cents per pound. He showed, by means of an example, in which an aluminum wire is to replace a mile of No. 10 B. & S. copper wire, that the price of the former is $22.59 against $22 72 of the latter. This is indeed a very small difference in cost and one which might easily be reversed by a slight fluctuation in the market value of the two metals. The arguments of Mr. Field are both novel and important and show that he has made a careful study of the problem. He says:

"The additional diameter of aluminum over that of copper for the same conductivity, will increase the cost of insulation for the same conductivity. The larger diameter also means more surface for the leakage of current, and the insulation resistance will be less, unless the thickness of the insulation is increased. An increased thickness of insulation means increased electrostatic capacity as well as greater cost. Moreover, it is found that if aluminum wires, of ordinary size, such as are used for electrical conductors, are bent once through an angle of 90° and back, they will break, whereas ordinary commercial copper conductors will stand from 15 to 20 of these same bendings before breaking. These are all objectionable features, and it would therefore seem doubtful whether aluminum conductors will prove merchantable. If such conductors are to be made commercially valuable it seems that the method of protection must necessarily be reduced to that of a mechanical covering, such as a braid or a series of braids treated with a bituminous composition to make it weatherproof, and also to assist in mechanical strength. This, however, will limit the use of aluminum for electrical conductors to special applications and prevent it from coming into general competition with copper."

He recommended very highly the use of aluminum fuses for switchboard work, on account of their not being altered by being traversed by a current. This was seconded by Mr. Dow, who also brought out this following important fact: In all parts of the United States a most important factor is the stress along an approximately horizontal line due to wind pressure. This stress is obviously proportional to the projected area normal to the line of stress—in other words, to the diameters of the wires strung on the pole line. The increased diameter of aluminum wire would require a much greater transverse strength of poles or much heavier bracing against wind pressure. One might expect that a pole line having aluminum conductors equal electrically to those in use by the long distance telephone company would be utterly wrecked at least once a year if erected in the lake regions, unless there were used about three times the numbers of poles, struts and stays that are customary for the existing copper conductor lines. Mr. Dow mentioned numerous practical applications of aluminum in the arts, concluding his remarks by what may be said to be a correct summing up of all the arguments brought forward and of the present situation, namely, that the new metal has been of much less value to electrical engineering than electrical engineering has been to the new metal and that this condition of affairs is likely to continue.

Insulation and Conduction.

A VERY exhaustive and highly valuable paper on the above subject was read by Prof. R. A. Fessenden before the A. I. E. E. on March 23, 1898, which embodied data accumulated by years of painstaking experimenting and reasoning. There is perhaps no question which has entered the practical side of electrical engineering as prominently as that of insulation and conduction; and few subjects which have been more frequently discussed and are less understood. A knowledge of the actual nature of conduction of currents must certainly give us a clue as to the nature of electricity itself, or perhaps a knowledge of the latter will give us information as to the process of conduction. And as no theoretical investigation can fail to produce practical results, for such is certainly the aim of every experimenter, so has Prof. Fessenden succeeded in giving to his co-workers, as the outcome of his highly scientific research, practical results which will prove of the greatest value. The paper may be divided into two parts, the first portion dealing with the theoretical side of the problem, the second, or practical portion, presenting data which to the manufacturer and designer will be highly useful and will save them trouble, time, expense and probably disaster, by not having to guess at the values of the insulation of certain materials and their degree of conduction. Prof. Fessenden's distinction between dielectric strength and ohmic resistance, which, together form the insulating power of a substance, was a fitting introduction to his theoretical, but non-mathematical portion of the subject. He then gave a brief account of the manner in which the current passes through materials, taking up in detail the questions of actual convection, which is of such

practical importance in high voltage transmission; of conduction in solids, showing that the conductitives of metals can be calculated from a formula embodying the elasticity, density and valency of the material; of conductivity in fluids, wherein he showed upon what factors this conductivity depends and which results will prove of the greatest value in electrolytic work; and of conductivity in gases, with special reference to Geissler tubes and enclosed arc lamps. Throughout this discussion Prof. Fessenden made use of striking analogies and always followed up his theoretical deductions by practical and commercial considerations. The subject of high resistance insulation, of which the author is certainly a master, was the opening wedge of what he himself terms the practical part of the discussion. He described methods of preserving the insulating qualities of rubber, and pointed out the disadvantages of glass and paraffin, and the great advantages of quartz for insulating materials in electrical instrument work. Oil he considered the best material for insulating resistance coils, and he dwelt on the importance of purity of materials used for condensers and induction coils, rather than their great ohmic resistance and dielectric strength. For making condensers, the advantage of heating the paper before using it was pointed out and supported by the results of experiments of the author and other authorities. Valuable information was presented on the construction of high frequency induction coils and the properties of oil, silk and pure cellulose, and he expressed the opinion that organic artificial rubber or non-inflammable substances which shall be elastic like rubber may be produced in the near future. Prof. Fessenden concluded his paper by discussing materials used for armature insulation and describing a couple of devices which he found useful in preventing insulation from being spoiled, such as the proper material to be used for soldering purposes. It is to be hoped that Prof. Fessenden will act on his own suggestion and at an early date supplement this highly interesting paper, which was very inadequately discussed on account of the absence of its author, by a book on insulation and conduction. It would indeed fill a long-felt want and be hailed as a valuable addition to practical electrical literature.

The Liquefaction of Air.

THE cheapening of the production of liquefied air within recent years and the remarkable results achieved therewith must have impressed everyone who has followed up the subject or has witnessed a series of experiments, with the future possibilities of liquefied air. On the same evening last week that Mr. Tripler, who has so successfully liquefied air in this country, lectured before the New York Society of Chemical Industries on the methods of liquefying air, Prof. William C. Peckham, M. A., showed some highly interesting and novel experiments with liquefied air furnished by Mr. Tripler before the Brooklyn Institue of Arts and Sciences and the Adelphi College. The very low temperature of the liquid, namely, — 346° F., enabled Prof. Peckham to freeze alcohol and mercury, to harden eggs and make rubber and all metals brittle, with the exception of aluminum. He made an ivory ball fluorescent by dipping it into the liquid, and reduced the resistance of a copper coil from 1.5 ohm to .9 ohm. The specific resistance of the liquid is said to be eight times that of water, which recalls to one's mind the following ingenious remark of Prof. Elihu Thomson some time ago: "Since ice at only 12 below freezing has a specific resistance of over 1,000 meghoms, i. e., as good as some brands of insulation, why not make the conductors hollow, lay them in a trench filled with water, pass cold brine through the pipes, use the brine for cooling houses, making ice, etc., and let the frozen water act as the insulator. A rough calculation shows that this is commercially feasible, even neglecting all sources of profit from the furnishing of the brine (i. e., if it were used only for cooling the pipes). After making all allowance for friction of fluid, cost of power, etc., the balance comes at the right end, if the line is always fully loaded."

Prof. Peckham also showed the magnetic properties of liquid oxygen and spoke of the possible use of liquefied air as a refrigerating agent. All the experiments were highly successful and can be repeated at a comparatively low cost and with very little trouble. Who can tell but that this new agent, now cheaply obtainable, besides possessing valuable properties as a refrigerating agent for cooling houses and preserving food, may give us an insight into the constitution of matter and the deep mysteries of the forces of nature?

Women in the Electrical Field.

THE various applications of electricity have for a long time past provided employment for large numbers of women, and such opportunities are growing in number. Electrical factories employ women freely; there are a great many women filling good positions in the telegraph field, and the bulk of work in telephone exchanges has always been done by girls, with much credit to all concerned. When we come to work of high responsibility, the bulk of it will probably always remain in the hands of men, but there are notable exceptions, and they appear to be decidedly on the increase. Last week our contemporary "Electricity" had the portrait of a Southern lady who is doing well as an electric light engineer and contractor, and this week we follow suit by presenting the portrait of a charming young lady in Ohio, who, at the age of twenty, is superintending a prosperous electric railway. We have recently recorded other instances, one of a lady in the South engaged in railway work, and one of a lady in New York State who makes a business of contract wiring. A few weeks ago a note was made of the employment of a married woman as "motorneer" on a New Jersey electric road, but we believe she is not now filling the position, chiefly because of objections on the part of her male companions on the road and of her husband. Still there are many lines of usefulness open, a fact of which we were reminded also this week in noting that the technical drawings attached to a patent were made by a woman who has long been doing in that field some of the best work possible.

The Correspondence School.

OUR announcement last week with regard to The Electrical Engineer Institute of Correspondence Instruction has, we find, excited widespread interest, as might have been expected. In these days every effort to add to the number of educational means and forces attracts attention; and while the standard of ultimate training is ever raised higher, the degree to which knowledge and culture become attainable is ever broadened. It is particularly in technical branches that the needs have been felt, and in a field of such sudden development as electricity the wants of the newcomers are as insistent as they are varied. The best comment on the value of the work to which this journal is now lending its support is to be found in the response of those whose necessities it is proposed to meet. If we had any doubts on that score, they are removed, and we are glad to believe that The Electrical Engineer is fostering a highly useful agency in the new scheme. The reading pages of the paper will have little to say hereafter about the school, it being a wholly distinct and separate institution, but we desire to inform those who do not receive the literature of the school at once, in response to their requests, that copies of the documents will reach them as soon as a further supply can be printed. We must beg to refer inquirers and applicants to the school itself, or to its advertisements, for such information as they may be desirous of obtaining.

Sudden Death of Mr. Nelson W. Perry.

WE regret to learn, just as the forms close, of the sad death of Mr. Nelson W. Perry, the well-known electrical journalist. He was experimenting, it appears, on Saturday last, in lighting, at his house in Brooklyn, and by mistake, in the dark, took up, and drank from, a cup containing bichromate of potash, instead of one of water. He sent out at once for doctors, but they were unable to pull him through, and he died on Sunday night. Mr. Perry was a son of Judge Perry, of the Supreme Court, of Ohio, a graduate of Columbia, and a man of great ability. He was an active member and officer of the American Institute of Electrical Engineers. He leaves a widow and three children.

MUNICIPAL AFFAIRS

Municipal Electric Lighting.[1]—VI.

BY PROF. JOHN R. COMMONS.

APPLICATION OF DEPRECIATION FUNDS.

THE above estimates for depreciation are of course not actually written off by the municipal officials, but are calculations made by Mr. Parsons. In fact it is almost invariably the rule that the managers of municipal plants make no allowance whatever for depreciation.

It is not to their discredit, however, as compared with private corporations. Mr. Foster says: "It is but fair to say that in a comparison of municipal with private plants, the charging for depreciation and interest, is fully as much neglected by one as by the other; less than one in ten of either paying any attention whatever to these items." The report of the Massachusetts Gas and Electric Light Commissioners shows that in 1896 the electric light companies of that State set aside for depreciation funds $446,662.89, which was 3 per cent. of the total assets of the companies. Two hundred and fifty thousand dollars of this was credited to one company, the Boston Electric. Of the eighty-three companies in the State, one thirty-three made an account of depreciation, and, apart from the Boston Electric, whose depreciation was 8 per cent. of its assets and 15 per cent. of its capital stock, and the Edison of Boston, whose depreciation was 2 8-10 per cent. of the capital stock, and 2 3-10 per cent. of the assets, the depreciation entered by the other thirty-one companies was less than one-half of 1 per cent. The Edison Illuminating Company of New York in 1894 for the first time carried a part of its profits to a depreciation fund, and the directors, remarking upon the novelty of the transaction, wrote: "This conservative course will no doubt commend itself to the stockholders."

As to these private companies, it does not follow, because they carry a depreciation fund, that they have actually written any depreciation off from their capital investment. The proper method would be to deduct depreciation from the capital and to add new construction, giving at the end of each year a new net capital investment, but as the companies are usually stocked and bonded at a high figure, it is of some advantage to them to keep adding new construction to their construction accounts without deducting depreciation, thus actually inflating their apparent investments. The depreciation fund which they carry is therefore merely a part of a larger policy which conservative corporations adopt, namely, the accumulation of a surplus in the treasury of the company rather than the distribution of this surplus in dividends to stockholders. This surplus may be invested in stocks and bonds of its own, or of other companies, or may appear in several different forms, such as profit and loss, depreciation fund, reserve fund, or insurance fund. By a policy of this kind the stockholders, though getting smaller dividends for the time, are nevertheless, while keeping up their plant by repairs, renewals, new construction, and operating expenses, increasing the market value of their stock, and their capacity to buy up and absorb other corporations and competitors, besides also giving added security to their bonds, and increasing the company's ability to borrow money at low rates.

Now, these conditions are wholly absent from a municipal corporation owning and operating an electrical plant. The taxpayers do not hold negotiable stock in the plant, which they may wish to hypothecate and so desire to have it backed by the possession of a reserve fund. They do not want the electrical plant to accumulate a surplus to be invested in securities against either future extensions of the business or replacements of worn-out machinery. The city is not a business corporation empowered to re-invest the earnings of its stockholders, the taxpayers; but the latter want to re-invest their own money in their own way and under their own individual control. Hence they want their dividends at once for private purposes in the form of low taxes or low charges. This leaves no room for the accumulation of a reserve by whatever name it may be known. If the municipality is to take account of the depreciation at all it is not in the form of a surplus fund on which the future taxpayers may draw in case of exigency, but it is in the form of such a provision for the distribution of depreciation over successive years that the taxpayers of no single year will be unduly oppressed. This will appear more clearly if we consider the true nature of the depreciation.

EXTENT OF DEPRECIATION.

There are three kinds of depreciation to be taken into account —depreciation by use, depreciation by competitive improvements and depreciation by replacements.

Depreciation by use is the actual wear and tear upon machinery, the burning out of armatures, the breaking of globes and lamps, the crippling of tools, the weathering of paint, poles, lines and so on. This kind of depreciation is entirely covered by the item of repairs and renewals, properly chargeable to operating expenses, and is so entered by every honest official. It does not need additional provision under fixed charges. However, it eventually contributes to the third form of depreciation, that of replacement.

Depreciation by competitive improvements consists in the lower cost of operation and maintenance which new inventions and improved machinery have introduced since the installation of the plant. It is asserted now that the saving effected in arc lighting by substituting 100 and 125 arc dynamos for the 35 and 50 arc dynamos of the earlier days is 40 per cent. of the maintenance. In the direct-current service the large units effect a saving of 20 per cent., which is increased even to 50 per cent. by being directly connected to the shaft of the engine instead of being belted. In alternating currents the difference is less, but the lower speed, lower temperature and ability to run continuously make their adoption a commercial gain. Such striking improvements in electrical machinery within ten years render the plants of that length of service quite antiquated. Were the business a competitive one and readily open to new companies there could be no question that the private plants installed a few years ago would all now be bankrupt, in so far as they have not met the improvements of the day by substituting new machinery. But having a monopoly and being able to charge the prices of a decade ago they are protected in the use of antiquated machinery and need introduce the new appliances only with the extension of new business. This kind of depreciation in a competitive business would be corrected by writing off depreciation from the capitalization, and the market value of the stock would sink gradually until bankruptcy or reconstruction ended it. But in a monopolistic business the power to keep up old rates is the power to withstand the pressure of competitive improvements. This is the very reason why in such a business municipal ownership, or at least municipal regulation of charges is demanded. And if the municipality, in case of ownership, did not choose to put in the new machinery before the old should wear out, the consumers certainly would be no worse off than with private monopoly. Certain it is that the charges by private companies for either public or private lighting have not fallen in proportion to the great improvements in production even where the companies have been enterprising enough to replace the old by the new machine. It is this kind of depreciation by competitive improvements that experts have in mind when they place depreciation at 10 per cent. For certainly the life of a dynamo is equal to the life of an engine if it be equally well cared for and if repairs are made as needed, and the depreciation by use in either case would not shorten the life of the apparatus to less than thirty or forty years. This kind of depreciation is not to be computed as a fixed charge, since it already shows itself in operating expenses by high cost of fuel, labor, repairs, etc.

Depreciation by replacement occurs as a result of the other two forms of depreciation, when old machinery through wear and tear and in view of improvements is sold out and new is put in its place. When this shall occur depends upon the policy of the management. A few enterprising private companies have already begun to reconstruct their electrical plants, not because of depreciation by use nor by competition, but because the saving with new improvements more than covers profits on the cost of reconstruction. As a rule, however, in a monopolistic business of this kind replacement does not occur until depreciation by use had advanced so far that repairs and renewal of minor parts fail to maintain the efficiency of the plant. Whether in the case of a city or a company, the financial circumstances of the owners determine how long they shall wait before selling the old and substituting the new. On this basis it will be safe on the whole to estimate that the entire depreciable part of the plant, including steam and electric plants, poles, lines, meters, transformers, lamps, should be replaced every twenty to thirty years. This

[1]Municipal Affairs, Dec. 1897. A Reply to R. R. Bowker. See Elec. Engr.

replacement would not occur all at once, but would be distributed throughout the period.

Municipal Ownership At Le Roy, N. Y.

The annual report of the Board of Water and Light Commissioners of this village, which has just been made, reveals a startling condition of affairs, and it is at once apparent that as a result taxes the coming year will be greatly in excess of what they have been. Before the water works were put in the taxpayers were told by the water commissioners that for the sum of one and one-quarter mills, added to the present rate of taxation, which was then $6.50 per $1,000 assessment that they would furnish a pumping station, help, coal, repairs, interest on bonds and all expenses attached to the water system. When it came to voting on a municipal lighting system the taxpayers were again made to believe that a municipal plant could be operated at a saving. At that time the village had an offer from the Hydraulic Company to light the streets for $2,000 per year for a term of five years. Now, by the report just issued, it is shown that the money needed to operate the municipal plant for the coming year with the same number of lights is $4,938. It had also been argued that the gas plant would be a profitable investment at $20,000, for the village to own. The report shows that to operate the plant $1,440 will be needed for coal, and the estimated receipts for the sale of gas only amount to $1,500. This would only leave $60 with which to pay the interest on $20,000, and also the help needed to run the plant, besides necessary repairs.—Rochester, N. Y., Advertiser.

ROENTGEN RAYS

J. J. Thomson's Theory of Röntgen Rays.

AN important contribution to this subject is made by J. J. Thomson. He bases his theory upon the known laws concerning the generation of an electro-magnetic field by a moving electrified particle. Such a particle "is surrounded by a magnetic field, the lines of magnetic force being (as in the case of an ordinary current) circles having the line of motion of the particle for axis. If the particle be suddenly stopped, there will, in consequence of electromagnetic induction, be no instantaneous change in the magnetic field; the induction gives rise to a magnetic field, which for a moment compensates for that destroyed by the stopping of the particle. The new field thus introduced is not, however, in equilibrium, but moves off through the dielectric as an electric pulse." The electrified particle in question is the "cathode ray;" the pulse generated by its sudden stoppage is the Röntgen ray. The author calculates the magnetic force and electric intensity carried by the pulse to any point in the dielectric, and arrives at some most suggestive and, indeed, corroborative conclusions. When the velocity of the particle approaches that of light, two pulses are started when it is stopped. One of these is a thin plane sheet whose thickness is equal to the diameter of the charged particle; this pulse is propagated in a direction in which the particle was moving; there is no corresponding wave propagated backward. The other is a spherical pulse spreading outward in all directions, whose thickness is again equal to the diameter of the charged particle, and thus, if this particle is of molecular dimensions or smaller, its thickness is very small compared with the wavelength of ordinary light. In vacuum tubes, the particles, whatever they are, are stopped by the walls of the tube, possibly after rebounding several times. The greater their velocity, and the smaller their mass, the more instantaneous will be the stoppage, the thinner and stronger will be the pulse, and the less of it will be absorbed in its passage through substances. The Röntgen rays are therefore not waves, but a rattle of irregular but intense impulses, something like bad musketry.—Phil. Mag., February, 1898.

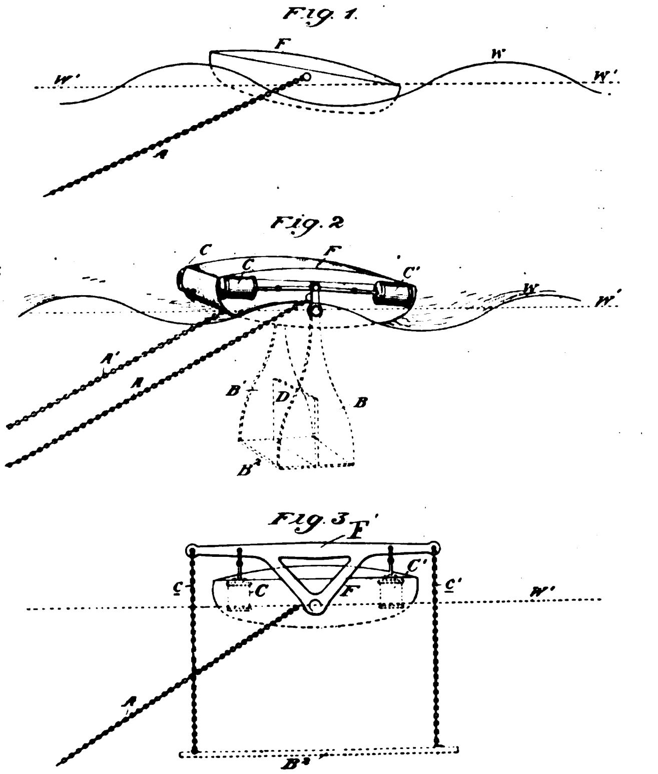
MR. PAUL H. JAEHNIG writes us: "I renew my subscription to your most valuable journal. I always find your paper right up to date, and a most valuable paper for a practical man; and would not be without it."

MECHANICAL

The Bunnell "Wave Motor."

A FORM of wave power apparatus which is fundamentally different from any of the several hundred existing types of motors in that line and which appears to present decided advantages in many important respects has recently been patented by Mr. Jesse H. Bunnell, the well known electrical manufacturer.

No piers, docks or permanent structures are employed excepting a stout anchorage capable of holding against any gale. Secured to this anchorage in the usual way of anchor fastening, by sufficient length of chain, is a strong seaworthy barge, boat or float. The anchor chains are, however, fastened to the barge or boat-hull at a point about amidship or a little forward of the same, so that the force of the waves will tend to give the utmost "pitching" or fore and aft rocking motion to the vessel, alternately lifting the bow and stern high in the air and dropping each in turn as the waves rise and fall—first under the bow and



Figs. 1, 2, and 3.—SHOWING THE PRINCIPLE AND INTERIOR MECHANISM OF BUNNELL'S WAVE MOTOR AND ITS APPLICATION.

then under the stern—as shown in Fig. 1 where F is the float and A one of the anchor chains, there being one on each side; W being waves and W^1 their mean level.

To convert the enormous force exerted by the rocking motion so produced into working effect, a great paddle is hung from the sides of the hull amidship to a depth sufficient to place it, the paddle, in still water below the wave motion. To the upper end of the paddle arms above the pivot center of motion are attached jointed piston rods connected with force pumps, as shown in Fig. 2, where F represents the float, B, B^1, two vertical lever arms pivotally secured on trunnions at opposite sides of the float, their lower and longer arms being broadened to support a horizontal bottom or surface B^2 and a vertical paddle D, the upper or short arms being connected by jointed piston rods, as shown, to the piston heads of four pump cylinders, C C C^1 C^1, operatively connected by properly constructed pumping tubes on the inside of the float with any form of motive device.

It will be evident that the violent and almost resistless rocking of the hull acting through the pump cylinders against the

nearly stationary paddle located in the still water must naturally exert a great power in forcing water through the pumps and into a suitable pressure chamber, from which it may easily be led to a Pelton wheel operatively connected to a dynamo, all contained under the deck of the floating vessel F; current so produced could be carried ashore by cable. A lift and fall of twenty tons through two feet, five times per minute, would amount to about 25 h. p. and for large work the vessel could easily be of several hundred tons displacement.

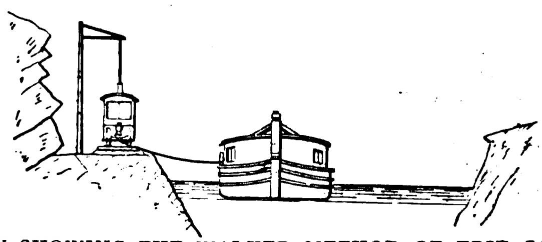
The absence of any necessity for stone work, piers, steel trusses and all the usual features of stationary structures would make the device comparatively inexpensive. The floats or hulls could be built in any ship yard, towed to and anchored wherever wanted, and removed to other points at pleasure: they could be of steel and adapted to withstand the most terrific storms.

Another form of this device which would be capable of application to light ships, stationary dock floats, and possibly even on sailing vessels for use in pumping is illustrated in Fig. 3. A submerged platform, B^4, is pivotally hung from the center of a float or hull F by chains c c^1 and two trusses F^1 F^1 and trunnions so that its entire body is below all wave motion and its upper surface in a parallel plane with the water level above, C C^1 being pump cylinders as before.

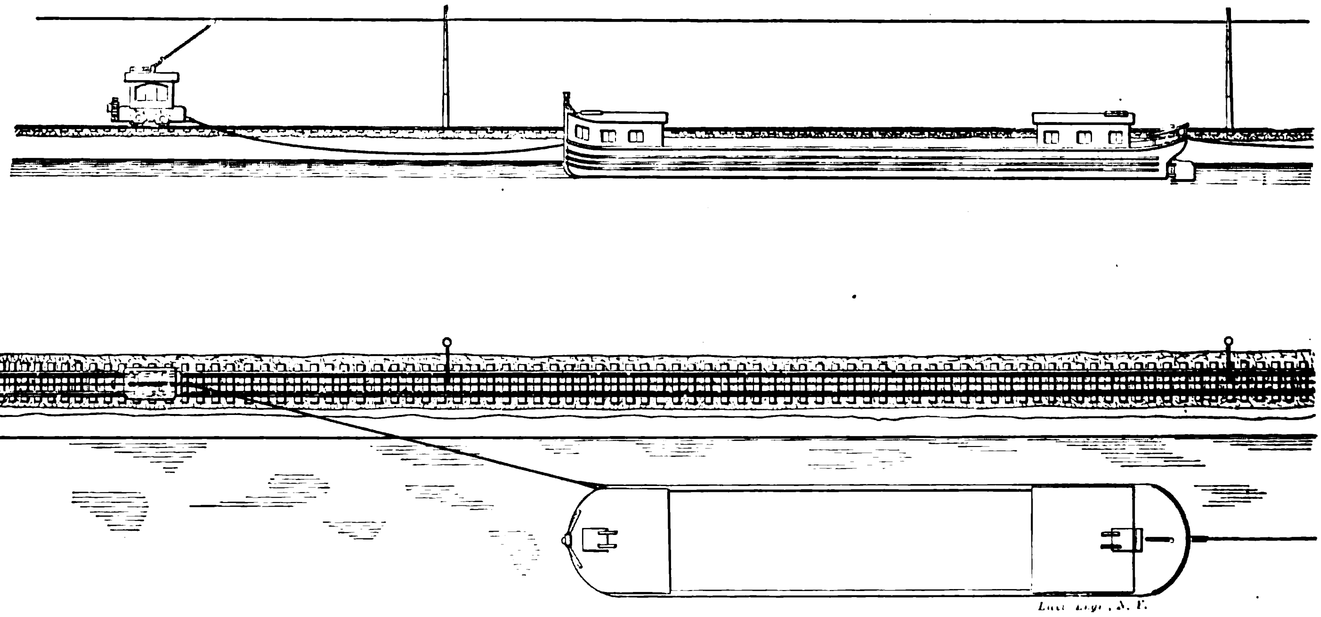
All the apparatus for the operation of this form could be carried aboard a sailing vessel, requiring simply the lowering from davits and submerging the suspended platform which would connect with pumps on board by chains. It is not unreasonable to believe that all the heat, light and power which would be required on board a light ship could be readily produced by this means due to the constant rocking motion of the ship.

Walker Plan For Electrical Operation of Erie Canal.

AMONG those who have recently addressed themselves to the problem of operating the Erie Canal and other canals electrically, with economy and efficiency, is Prof. S. H. Short, on behalf of the Walker Manufacturing Company, of Cleveland. The proposed experiments are about to begin at Tonawanda, and we have been favored by Mr. Frank W. Hawley with the plan to be used, and it will be powerful enough to haul a tow of five boats, each of 250 tons burden, at the rate authorized on the canal, namely, not exceeding six or eight miles an hour at the most, in order that the wash from the boats shall not undermine the banks. The drawings herewith are so simple as to be self explanatory, but the details of providing for adjustment to curves, strains, etc., are not given out for the present. Prof. Short believes in the great cheapness and economy of this method, having long had the subject under study, and he considers that it has as many incidental advantages as some other methods have objections, even if they may claim greater novelty.



VIEW SHOWING THE WALKER METHOD OF ERIE CANAL BOAT PROPULSION.



WALKER METHOD OF ERIE CANAL BOAT PROPULSION.

that is to be tried. In the present case, it is the intention to haul a tow of boats by means of a locomotive on a track paralleling the canal, the track being placed in actual operation on the berme bank of the canal. A mining type of locomotive is

Important Electric Railroad for Michigan.

An organized company formed with George E. Taylor, of Flint, Genesee county; J. E. Sawyer, Hon. S. W. Smith, of Pontiac, Oakland county, and other parties, recently obtained franchise and will build an electric railway from Pontiac to Flint, covering one of the most richly fertilized and industrial territories of the State of Michigan for a distance of about forty miles northwest of Pontiac. The route of this proposed road has been already carefully surveyed and from Pontiac will run through and have stations at Drayton Plains, Waterford, Clarkston, Ortonville, Goodrich, Atlas, Grand, Blanc, to Flint. All these small towns at the present time are without facilities of transportation, and an electric railway will undoubtedly find ample and profitable traffic both in the passenger and freight line.

The location of this road will be in the hearts of Oakland and Genesee counties, which are thickly settled with a number of small towns and villages, with flourishing trade and abundant farming produce. The road will be solidly built, and 70-lb. T. rails used, so that heavy traffic can be carried on it equal to any steam roads. The best electric apparatus will be used, and two power houses will be built, respectively located one in Pontiac the other in Flint. Interested parties are now negotiating with Eastern capitalists and the company contemplate to start the grading of the line within a few weeks. For particulars and

more ample information, Joseph E. Sawyer, Esq., attorney at law, Crofoot building, Pontiac, Mich., will be glad to be addressed.

Miss Anna E. Mitchener, Superintendent of the Tuscarawas Electric Railroad.

THE electrical engineering profession would indeed be narrow if it did not offer to the ambitious and courageous woman an opportunity to give evidence of her proverbial executive ability and foresight. Of late years thousands of women have found employment in the various departments of electrical manufacturing concerns, as private secretaries and in other electrical work congenial to their tastes. But never before have we had occasion to record in our pages the remarkable fact that a young woman is actually superintending an electric railroad. The Tuscarawas Railroad Company, of Ohio, which owns and operates an interurban road, ten miles in length, connecting the twin cities of Uhrichsville and Dennison with New Philadelphia, is a well equipped, thoroughly modern line, with power house, car barn and office, located about half way between Uhrichsville and New Philadelphia. When the road was formally opened in September, 1896, Miss Mitchener was given a place in the office, where, under her father's careful direction, she became acquainted with the inner workings of the great problems involved in street railway work. Miss Mitchener has held her present position, as superintendent, since last November and in this brief period has met with marked success, which is largely due to the fact that the employés of the road are all carefully selected and thoroughly trustworthy men. She has at all times endeavored to meet them on a friendly footing and to make them feel that they, too, had an interest in the welfare of the road. In this way she has been able to maintain perfect order and union among quite a large force of men who might otherwise have resented being superintended by a young girl of twenty. It may be stated that the company was organized at Columbus, O., with an authorized capital stock of $150,000, and its officers are: President, Will Christy; vice-president, C. E. Mitchener; secretary, and treasurer, C. H. Howland.

LETTERS TO THE EDITOR

The Jungfrau Road.

We notice an article in your issue of February 24, describing the railway now under construction up the Jungfrau. A list is given at the end of the various firms who have supplied the different parts of the plant, but we notice that no mention is made of the fact that we have supplied the whole of the electrical equipment of the locomotives there illustrated. We would be glad if you would kindly make this fact known in a forthcoming number. The omission seems to us the more unfair, since it was at our suggestion that three-phase motors have been adopted as the actual driving power on the locomotives. It may be true, as the writer of the article states, that "Electricians have, almost without exception, recommended alternating currents as working most economically for long distances." But they never thought of using them directly on the locomotive itself until on a small scale in the Lugano tramway, and later on the Gorner Grat mountain railway, we showed it to be practically possible. The contract for the Gorner Grat railway, for which we have supplied the whole of the electrical equipment, was given more than a year before it was decided to adopt the same system on the Jungfrau line, and the successful trial trips which were made on it, as noted in your issue of December 23 last, proved that we were justified in our proposal to employ three-phase currents throughout.

BROWN, BOVERI & CO.

Baden, Switzerland, March 9.

"Blind Leading the Blind."

THERE is perhaps no subject of greater interest and usefulness to the electrical engineer of to-day than the design of dynamo-electric machinery, and, though many books and articles have been written on the theory, design and construction of dynamos and motors, it still appears that very few writers have "filled the long-felt want" of a practical treatise on the subject. Who will deny, for instance, that nine persons out of every ten, when asked what book to purchase on dynamo electric machinery, will answer, "Why, Thompson's," and this, regardless of the many books and articles which have been published since the appearance of Prof. Thompson's excellent treatise.

Naturally, then, the publication of the book entitled "Practical Calculation of Dynamo Electric Machines," by Alfred E. Wiener, E. E., M. E., was looked forward to with a great deal of expectation.

No sooner had it appeared, however, than we found it attacked by men of prominence in the electrical engineering field, men whose opinions cannot pass unnoticed. The writer has read with a great deal of interest the able criticism by Mr. Thorburn Reid and the chivalric refutation of this "virulent attack" by Mr. Wellman, in the columns of The Electrical Engineer. Not being desirous of entering this controversy or prolonging a discussion which appears to become rather personal, the writer will not review any particular portion of the book, but simply make the following statement, which should be made at this time in justice to the men who give a timely warning to those intending to use the book for the "practical" calculation of dynamos or motors.

When the articles by Mr. Wiener appeared in one of your contemporaries, the writer had occasion to design a large multipolar generator. Not having had much practical experience, he freely made use of the "practical" data presented in the tables in those articles. The dynamo was designed, but had a picture of it appeared it would probably have been labeled "A Dynamo or Similar Machine Designed by One of the Inmates of ———." The professor of electrical engineering of one of the leading universities in this country testified to the correct use of the "incorrect" data and from that time on forbade the use of the data in those articles by the students in that university, and later the book, which did not have the errors corrected. Names are withheld for reasons which must seem obvious, but the force of this action based on a thorough and unbiased persual of the book, must be admitted by everyone who seeks serviceable information and will assist in purging electrical literature from unreliable and misleading statements.

ENGINEERING STUDENT.

New York, March 25, 1898.

The Telephone in Washington, D. C.

I NOTICE in the last two issues of The Electrical Engineer a statement indicating that the complaint against the Telephone Company of the District of Columbia arises from the simple fact that a party had to get a bill changed in order to pay for a message. That such is not the fact, I enclose herewith a copy of the memorial presented to Congress by those using telephones.

In the meantime, the matter is being investigated by a committee of Congress, and when their report is presented I think you will find that there is good ground for complaint.

The company controls the District of Columbia and Maryland, and it is well understood that it is practically owned and controlled by the Bell Company, to whom a large amount of stock was issued without any, or for a merely nominal, consideration. The president of the company admitted that the stock had been largely watered, and when asked what this excess of stock represented, he replied, 'The value of franchises, right of way," etc.

Inasmuch as the company has never paid one cent for its franchises, or right of way, and insists on charging rates that will enable it to pay dividends on this watered stock, it simply

amounts to making the public pay for the privileges which the public has conferred on the company.

In Baltimore, where this same company operates, the city authorities have permitted a rival company to be established, and the result is not only a much cheaper rate, but also a rental paid the city for the use of the conduits built and owned by the city, which rental already amounts to 4 per cent. on the entire cost of the conduits, and which, when the conduits are fully occupied, will amount to over 20 per cent. on their cost.

Other companies have offered to do the same here, and the citizens fail to see any good reason why it should not be done, or, in lieu of that, why the charges and rules of the present monopoly should not be regulated by law, so as to be reasonable. There is no one who is not willing that the company should charge sufficient to pay a reasonable interest on the capital invested, and beyond that no corporation enjoying free public franchises has a right to go.

As Boone, on Corporations, says, "Charters should never be granted but for the public good, in consideration of services to be rendered the public, and not to advance private gain;" and as Judge Cooley says, where competition does not exist or fails to produce reasonable service, they should be regulated by the authority which confers the franchise.

That is what the citizens here seek to have done—"only that and nothing more"—and the more corporations resist such reasonable efforts the more do they cultivate the feeling in favor of municipal ownership, or still more stringent regulations as to corporations.

Up to the present time, corporations, trusts and combines have controlled legislation, national, State and municipal; but there is an awakening of public sentiment on this subject throughout the land that will result sooner or later in a correction of the abuses, or action that will be even worse for the corporations which enjoy public franchises.

It will seem to be the part of wisdom for such corporations and their organs to meet this movement with a spirit of fairness for their own sake, as otherwise they will but "kill the goose that lays the golden eggs" for them. W. C. DODGE.

Washington, D. C., March 24, 1898.

MISCELLANEOUS

Wellman's Marine Torpedo.

IN the use of marine torpedoes, while there is no difficulty in bringing the torpedo into close proximity to the vessel to be destroyed, it is often very difficult to bring it into intimate contact therewith. Generally, it is not desired to explode the torpedo until after the diver or operator placing same has retired to a safe distance, and heretofore it has not been possible to readily secure it to the metallic armored hull of a war vessel, and, to a certainty, have it retain its original placed position, until the diver is at a sufficient distance away so as not to be injured by the final explosion.

With this in view, the torpedo invented by H. Page Wellman, of Ashland, Ky., and illustrated above, is provided with electromagnets located near its forward end, the purpose of which is to temporarily secure it to the metallic armored hull of a battleship or war vessel until such a time as the operator desires an explosion. The coils of the magnets are energized by either a primary or storage battery located within the torpedo shell. A single pole switch is included in the circuit, in series with the battery and magnet coils, which is closed by the operator before it is started on its errand of destruction. The closing of the switch terminals, permits the electrical current to circulate through the magnet coils, which create powerful magnetic fields on the ouside of the torpedo shell, the effect of which is to instantaneously secure the torpedo to the iron or steel hull of the vessel, with which it has come into contact. It will then remain securely moored in immediate contact with the hull until the battery current is interrupted either through an outside agency or through explosion.

The core ends or poles of the magnets may extend entirely through the non-magnetic shell of the torpedo or about immediately against the inside of same, also, they may be extended outside the hull of the torpedo ana to these ends may be pivotly secured magnetic metal plates which act as swivel pole pieces, and which, when the torpedo is under way, cling closely to its sides and offer but little resistance to its passage through the water. Upon coming in contact with the metallic hull of a war vessel, these swivel ends or plates open out and present a large magnetic contact area to the hull, thus more readily adopting themselves to the irregularities of the surfaces in immediate proximity. Iron linked plates or chains may also be secured to the exposed magnet core ends in place of the metal plates, care being taken that the chains are not long enough to extend between and connect the ends of the magnet cores, thus short-circuiting their magnet field and rendering their operation ineffectual.

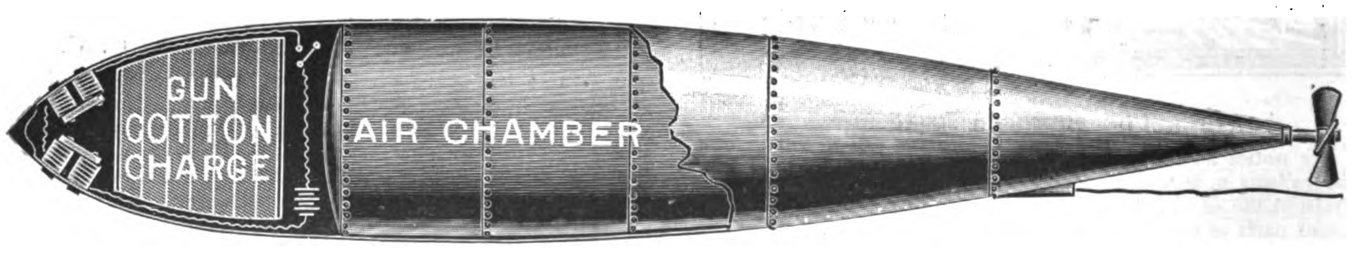
The apparatus is especially valuable with torpedoes to be used in connection with submarine boats, as upon reaching the vicinity of the vessel to be destroyed, the diver emerges from within the submarine boat with the torpedo, and, placing it in contact with the vessel's hull, he retires to a safe distance before exploding it.

Telephone In Schools.

A Chicago paper asks a question which might be put in Albany as to why the public school buildings of the city are not connected with the office of the board of education by telephones. If it is said that the expense would be too great it may be replied that there are economies that do not economize and that this is one of them.

It has happened that because of the unexpected illness of a teacher a room has had to be closed for the entire day for the reason that a substitute was not at hand, when with the use of a telephone one might have been summoned in fifteen minutes. Every principal in the city knows how he or she has been perplexed for fear that the non-arrival of coal would make compulsory the closing of the building. The way the fuel is delivered makes it possible that the building will be short of coal any day or at any time of the day. It is often the case that the attendance of a physician is immediately demanded, but there is no way of hastily summoning one. In case of fire only the ordinary appliances are at hand to call the fire department, and, while these are good, a schoolhouse with 800 children ought not to be made to depend solely on the common methods of protection in case of an emergency.

There are often times when for the public good the principal wishes for a moment's consultation with the superintendent. The truth is that one of the large school buildings has more urgent necessity for a telephone than half the business houses in the city have. These appliances are comparatively cheap



WELLMAN'S MARINE TORPEDO.

and have become private necessities, and to deprive the schools of them is virtually to cripple their efficiency and to run risks that the Board of Education ought not willingly to assume.—Albany Press.

Electrical Companies in Recent Chicago Fires.

The recent disastrous fire on Wabash avenue, Chicago, in which so many lost their lives, numbered among its victims both the personnel and property of the W. A. Olmsted Scientific Company. Mr. W. A. Olmsted, president; Mr. Arms, secretary; Mr. Wilcox, treasurer and the company bookkeeper, all lost their lives; and the stock and records were all completely destroyed. The concern seems to have been as completely wiped off the face of the earth as is possible with a corporation. The disaster is appalling. A few days later the fire which destroyed the Schoneman building on Dearborn street destroyed the property of the Atlas Electric Company, a house goods manufacturing company. The F. B. Rae Engineering Company and Sargent & Lundy also lost some goods in the latter fire.

SOCIETY & CLUB NOTES

New York Electrical Society.

The 186th meeting of the society will be held at the College of the City of New York, Lexington avenue and Twenty-third street, on Wednesday, March 30, at 8 p. m. Mr. Frank E. Knight will read a paper on "The Influence of Electric Railroads on Population and Land Values in Cities." After this paper, Mr. W. J. Clarke will give a practical demonstration of the Marconi system of wireless telegraphy by means of an improved apparatus. On behalf of Mr. John Dennis., Jr., the inventor of the Fluorometer, Mr. Clarke will also describe the operation of that instrument as a surgical adjunct of the X-ray.

American Institute of Electrical Engineers.

At the meeting of the Institute, held at 12 West Thirty-first street, New York, March 23, a paper was presented by Prof. R. A. Fessenden on "Insulation and Conduction." About 75 members and guests were present, with President Crocker in the chair. In the absence of the author, the paper was read by Mr. R. W. Ryan and discussed by Prof. Franklin and Dr. Pupin.

The secretary announced that at the meeting of the council in the afternoon the following nominees had been selected from the proposals submitted by the membership: For president, Arthur E. Kennelly; for vice-presidents, Robert B. Owens, William Stanley, Cary T. Hutchinson; for managers, Herbert Lloyd, Samuel Sheldon, George F. Sever, Charles P. Steinmetz; for treasurer, George A. Hamilton; for secretary, Ralph W. Pope.

The following officers continue their terms as provided in the constitution: Vice-presidents, A. E. Kennelly, Charles S. Bradley, D. C. Jackson; managers, J. W. Lieb, Jr., F. A. Pickernell, W. L. Puffer, L. B. Stillwell, Alexander Macfarlane, W. F. C. Hasson, Gano S. Dunn, Herbert Laws Webb.

The question of standardization of electrical machinery was referred to a special committee, composed of Elihu Thomson, Francis B. Crocker, A. E. Kennelly, C. P. Steinmetz, C. T. Hutchinson, J. W. Lieb, Jr., L. B. Stillwell.

The following associate members were elected: Albert G. Davis, acting manager, patent department, General Electric Company, Schenectady, N. Y.; Albert R. Gallatin, student at Columbia University, residence 58 West Fifty-fifth street, New York City; Herbert Gaytes, electrical engineer, Realty Syndicate Railways, Piedmont power house, Oakland, Cal.; Russell Agnew Griffin, purchasing agent, American Telephone and Telegraph Company, 15 Dey street, New York City; Francis Valentine T. Lee, engineer (Pacific coast department) Stanley Electric Manufacturing Company, 300 California street, San Francisco, Cal.; Max Loewenthal, associate editor, The Electrical Engineer, residence 831 Park avenue, New York City; Henry W. Pope, special agent, American Telephone and Telegraph Company, residence 200 West Eighty-third street, New York City; Fritz Reichmann, instructor of physics, the University of Texas, 309 East Eleventh street, Austin, Tex.; Theodore E. Theberath, Pacific coast engineer, Stanley Electric Manufacturing Company, 300 California street, San Francisco, Cal.; Robert Anton Fliess, student of electrical engineering, Columbia University, residence 201 West Fifty-fifth street, New York City.

The opening date of the general meeting at Omaha was fixed for June 27 and its continuation for either three or four days has been left with the Committee on Papers and Meetings for decision.

Large Accessions to the New York Electrical Society.

One of the most striking evidences of the general interest that the exhibition is awakening is to be found in the remarkably large accessions to its membership which the New York Electrical Society has enjoyed since the exhibition was announced under its auspices. The desire of the society to promote the welfare of electrical applications is recognized as highly laudable, and has elicited not only many words of commendation, but has brought the largest numbers of applications for membership within a given time that the society has known in its history. Last month the secretary announced a list of a round score of new members, and he now states that the applications for March will reach close upon 50. In almost every instance, the new members inquire as to the exhibition, and express the wish to aid it in any way possible.

Prize Essays.

A special committee of the Auxiliary and Educational Committee has just drawn up on behalf of the exhibition a plan whereby prizes to the value of not less than $100 are offered to the pupils in the public and private schools in New York and its vicinity for essays on the Electrical Exhibition. This committee, comprising Prof. F. B. Crocker, Mr. G. H. Guy and Mr. T. C. Martin, has realized the fact that a great many young people will visit the exhibition, not merely from idle curiosity, but from a desire to learn, and it is believed that many such visitors will be encouraged in this way in their intelligent study of electrical principles, phenomena and inventions. The essays will be limited to 1,500 words, and will be accepted up to May 18, the awards being declared and prizes presented not later than May 28. No contestant is to be over 16 years of age, and the judges will be selected chiefly from the staff of the colleges and schools of New York City. Copies of the circular will be ready this week.

Widespread Interest in the Electrical Exhibition.

The interest taken in the Electrical Exhibition is by no means limited to Greater New York, and extends in every direction. Numerous comments have been made by the foreign press, and by journals in different parts of the country, and Prof. R. B. Owens, director general of the electrical work at the Omaha exposition, beginning in June, has been specially instructed to visit this city in May, and acquaint himself with the exhibits and the work being done. Many inquiries have come from foreign managers and manufacturers, as to the time and nature of the exhibition, and it is a fact beyond question that a direct stimulus will be given to export trade. As was the case at the exhibition in 1896, many of the exhibits will go straight from the floor to foreign countries.

McCullagh Police Signalling System.

One of the universal complaints in regard to a policeman is that you can never find him when he is wanted. Many measures have been taken to remedy this state of affairs, and resort has been made to the telephone signalling systems, etc. Chief McCullagh, the head of the police force of Greater New York, who has been in the service for 30 years, has studied this

problem intimately, and has evolved a system of communication, which marks a new departure in the police supervision of any large community. He proposes to establish a certain number of policemen at stated points all over the city, connecting their booths, or sentry boxes, up by telephone with the police station of the precinct. No matter what happens, anyone who wants the help of the police can go at once to these well known points and obtain the service of the officer there, he, in turn, notifying his headquarters of the call, and securing a relay in the shape of one officer or a dozen, as the case may need. It will be obvious that such a system not only gives instantaneous police help, but by establishing a series of trochas, make it very hard for a fugitive criminal to break through, as he is liable to interception in whichever direction he goes. Chief McCullagh has kindly promised to have on exhibition at the Garden in May one of these novel and interesting booths, which, in the course of a few years, will doubtless stud the sidewalks of all our great cities.

As far as possible the method of communication will be shown in operation, and the public will be able to realize practically the manner in which a long step forward is being taken in increasing the efficiency of the police force, and in deterring crime. The city has recently made an appropriation to help carry out this McCullagh system.

The Telegraph Tournament.

Signs are already visible of the keen spirit of rivalry which has been aroused in telegraphic circles by the announcement of the coming tournament. Already the cracks in many cities, both in the States and in Canada, are getting themselves into training. Some of the Montreal operators have written to ask whether they will have the same show as their American competitors. The reply they received assured them that they would have an open field and fair play, and they are now busy getting their contingent in racing form. In other cities, such for instance as Chicago and Philadelphia, the telegraphic fraternities are uniting to raise additional prizes to be given to the successful contestant from their city at the tournament.

The complete list of judges includes the names of A. S. Brown, Western Union Telegraph Co.; Francis W. Jones, Postal Telegraph Co.; A. E. Sink, manager Western Union Telegraph Co.; Chas. Shirley, manager Postal Telegraph Co.; Geo. H. Usher, superintendent Postal Telegraph Co.; D. B. Mitchell, manager Race Bureau, Western Union Telegraph Co.; Minor M. Davis, traffic manager, Postal Telegraph Co.; Gardner Irving, manager Commercial News Dept., W. U. T. Co.; S. F. Austin, Commercial Cable Co.; P. J. Tierney, manager Central Cable Office; F. F. Norton, and S. A. Coleman, chief operators Postal Tel. Co.; E. F. Cummings, night manager Western Union Tel. Co.; Edwin F. Howell, secretary Serial Loan Ass'n; E. T. Barberie, Postal Telegraph Co.; Chas. Thom, chief of Quadruplex Dept. Western Union; E. H. Cox, manager, and E. W. H. Cogley, assistant superintendent Associated Press; Thos. R. Taltavall, editor Electrical World; E. A. Leslie, Manhattan Electric Light Co.; J. H. Bunnell, Electrical Manufacturer; H. W. Pope, Telephone Supt.; Wm. Maver, Jr., Electrical Expert; Robt. W. Martin, cable editor N. Y. Sun; P. B. Delany, Telegraph Expert; Edward H. Johnson and Thos. J. Smith, Electrical Manufacturer; Judge of Press Code, Ed. H. Curlette and P. T. Brady. All the judges are expert telegraphers. The selection has been so carefully made and the list includes so many men in the front of the electrical as well as the telegraphic industry, that every contestant may be assured that his individual interests will be protected. Phonographic and other records of each transmission will be made, so that in the event of any dispute the work may be reproduced. The judges of the typewriting contest are Chas. W. Price, editor Electrical Review, T. C. Martin, editor Electrical Engineer, W. D. Weaver, editor American Electrician, J. B. Taltavall, editor Telegraph Age and G. H. Guy, secretary New York Electrical Society.

MR. SOL. BERLINER, who has been confirmed as U. S. Consul to the Canary Islands, will be glad to come into touch with electrical concerns that desire to introduce their goods in the Islands or be represented there. He leaves on April 7 and can be addressed at 271 Broadway.

MR. JAMES BURKE, the well known designer of dynamo electric machinery, has sailed for Europe. He has accepted the position of consulting engineer for the Bergmann Electromotoren & Dynamo Werke of Berlin, in which Mr. S. Bergmann, of this city, is so prominently interested. He carries with him the good wishes of a host of friends and admirers.

MR. ERNST THURNAUER, director of the French Thomson-Houston Company, has been here on a short trip and has just returned home to Paris. He is much gratified at the progress here and with prospects in France.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued March 22, 1898.

Alarms and Signals:—

BURGLAR AND FIRE ALARM. D. H. Talbert, Knightstown, Ind., 601,181. Filed Oct. 29, 1897. The opening of a door or window releases a normally closed push button held out of contact by a weight.

ELECTRICAL ALARM-GAUGE. J. Hackney, Norfolk, Va., 600,866. Filed June 24, 1897. The indicating needle makes contact with contact points imposed in its path at predetermined points.

Batteries, Primary:—

BATTERY. W. Morrison, Montclair, N. J., 601,042. Filed Jan. 20, 1896. A battery case consisting of non-conducting material and having an independent cap molded in it insulated from the top and opening into the interior of the case, and a carbon provided with a shoulder driven in the cap.

Conductors, Conduits and Insulators:—

CONDUIT. L. Skaife, Montreal, Canada, 600,935. Filed June 5, 1897. Comprises a conduit length of oblong form having parallel flat top and bottom, inclined sides, and a centrally located longitudinal circular passage, the sides being at such angles as to make them radial from a given center.

HIGH POTENTIAL INSULATOR. J. W. Boch, East Liverpool, Ohio, 601,195. Filed Feb. 1, 1898. A high potential porcelain insulator having a supporting post made of two tubes, one fitted within the other with an intermediate tubular layer of glaze.

Dynamos and Motors:

ALTERNATING CURRENT MOTOR. W. Langdon-Davies, London, England, 601,023. Filed Nov. 15, 1897. An alternating current motor in which the starting coils are of numerous turns and relatively high self-induction as compared with the running coils in which a resistance is added starting to the circuit through the running coils.

Electro-Metallurgy:—

METHOD OF AND APPARATUS FOR EXTRACTING GOLD FROM ITS ORES. E. W. Von Siemens, deceased, F. W. Whitridge, administrator, New York, 601,068. Filed May 28, 1890. An apparatus for obtaining gold from a weak cyanid solution by electrolysis, combining a cell provided with anodes of iron and cathodes of lead formed of thin plates, the cathode plates having from nine to ten square meters of surface to each ton of solution in the cell, and subjecting it to a weak current of electricity.

Lamps and Appurtenances:—

ELECTRIC CIRCUIT CLOSING DEVICE. G. Newman, El Paso, Tex., 600,969. Filed Sept. 27, 1897. A key for lamp sockets in the face of which is imposed a recess, the inner part of which is covered with phosphorescent paint.

CLUSTER FIXTURE FOR ELECTRIC INCANDESCENT LAMPS. N. Weeks, New York, 601,108. Filed Oct. 1, 1897. A fixture that may be applied directly to a ceiling and in which the usual short extended end of the house-wiring may be attached directly to the lamp contacts.

Measurement:

ELECTRICAL MEASURING INSTRUMENT. E. Weston, Newark, N. J., 600,981. Filed Dec. 7, 1897. Comprises two current measuring instruments attached to a common base and having their indicating needles so located with relation to a common scale that independent readings may be taken at the same instant.

ELECTRICAL MEASURING INSTRUMENT. E. Weston, Newark, N. J., 600,982. Filed Dec. 7, 1897. The removable coil is either partially or wholly immersed in a dampening liquid.

ELECTRICAL MEASURING INSTRUMENT. E. Weston, Newark, N. J., 600,983. Filed Dec. 7, 1897. Designed for alternating currents and provided with two indicating needles and a scale wholly inclosed within the casing of the instrument, one of the needles being operatively connected with the movable part of the instrument and the other with extraneous means for mechanically moving it to various positions.

Miscellaneous:—

ELECTRICAL DEVICE FOR PROPELLING BOATS. L. R. Jones, Boston, Mass., 600,874. Filed July 2, 1895. Employs a motor mounted on the rudder shaft and adapted to turn a propeller by means of its shaft connected to the screw by bevel gear.

DAMPER GOVERNOR. C. Kummer and T. Bertrand, Easton, Pa., 600,966. Filed May 9, 1896. Controlled by a thermostat in conjunction with electrical apparatus connected to a battery.

IGNITING DEVICE. J. T. Armstrong and A. Orling, London, Eng., 601,069. Filed Dec. 21, 1896. Designed for gas lamps. Details of construction.

MAGNETIC CLUTCH AND POWER STATION SYSTEM. B. J. Arnold, Chicago, Ill., 600,941. Filed June 20, 1896. Combines with a driving shaft, two power transmitting shafts, one hollow and encircling the other, a power transmitter normally operatively connected with the hollow shaft, and a driving connection device adapted

to operatively connect the hollow shaft with either of the other two shafts.

Railways and Appliances:—

BRAKE FOR ELECTRIC MOTOR CARS. P. B. Hayes and H. M. Carbine, Chicago, Ill., 601,206. Filed Dec. 23, 1896. Comprises a wheel brake mechanism, an auxiliary brake mechanism for the armature shaft of the motor and an equalizing lever operated from the car platform and having operative connection with the wheel brake mechanism and the armature shaft brake mechanism.

TROLLEY WHEEL. A. B. Collett, Lynn, Mass., 600,857. Filed May 28, 1896. Means whereby the material worn from the wheels by contact against the trolley wire may be supplied without the necessity of a new wheel body.

TROLLEY WHEEL. E. R. Robinson, Chicago, Ill., 600,890. Filed Nov. 28, 1896. Combines with the fillings of the wheel, of shots of the filling material, which extend through openings in the wheel to electrically connect the lining with the trolley arm independently of the main body of the wheel.

PNEUMATIC CONTROLLING SYSTEM FOR ELECTRIC CARS S. H. Short, Cleveland, Ohio, 600,896. Filed Sept. 20, 1897. Comprises pneumatic means for controlling all the motor controllers in a train of cars from any car in the train.

ELECTRIC CONTACT BOX. J. N. Thomas, Johnstown, Pa., 600,937. Filed Sept. 18, 1897. Combines with the terminals of a switch, means for opening the circuit thereto when the separation of the terminals draws an arc between them, the means being actuated by the heat developed by the arc.

Roentgen Rays:—

PORTABLE CAMERA FOR ROENTGEN RAY PHOTOGRAPHY. G. Seguy, Paris, France, 601,172. Filed March 23, 1897. Comprises a complete installation, consisting of a battery, and induction coil, a Crookes tube, and the parts required for a complete operation encased in a portable box of relatively small size.

Telephones:—

TELEPHONE. G. F. Payne, Philadelphia, Pa., 600,990. Filed Aug. 21, 1897. Employs a perforated electrode adjacent to the diaphragm, a rod extending from the diaphragm through and movable in the perforated electrode, an electrode secured to the rod and granular conducting material situated between the electrodes.

TELEPHONE TRANSMITTER. G. F. Payne and W. D. Gharky, Philadelphia, Pa., 600,991. Filed Sept. 11, 1897. Provides a transmitter in which the form and amplitude of the vibrations of the diaphragm will be converted into alternating electrical impulses.

DROP SIGNAL APPARATUS. O. A. Danielson, Owatonna, Minn., 601,222. Filed May 13, 1897. A series of sets of magnets, a set for each drop, comprising a multiplicity of magnets, adjacent sets being so arranged that magnets of one set will oppose magnets of the adjacent set.

LEGAL NOTES

The Stieringer Fixture Patent Sustained.—George Maitland vs. B. Goetz Mfg. Co.

On March 2 the United States Circuit Court of Appeals for the Second district handed down a decision upholding the validity of claim No. 1 of the reissued Stieringer fixture patent, reissue No. 11,478, March 11, 1895. In an extended opinion the Court reviews the testimony and holds that both on the ground of novelty, as well as of patent ability, the Stieringer reissue is valid.

THE STOCK MARKET

Fears of War and Lower Prices.

The general state of trade continues excellent, and some branches are extremely busy. In iron and steel the demand is enormous, not for warlike purposes merely, but in the beneficent arts of peace. A pig iron famine even is predicted. The reports of the activity of interior trade are very encouraging, and it is evident that the conditions everywhere would have approached a "boom," but for the nervousness induced by the prospect of war.

On the Stock Exchange last week, 14,618 shares of Western Union exchanged hands at prices between 86 and 82¼, closing at 84½. General Electric, after sales of 8,930 shares, closed at 31¾. New York Edison sold at 125¼. In Boston, American Bell telephone on sales of 982 shares fell to 240 from 244½, the dividend "coming off." Calumet and Hecla, copper stock, went to 515, on sales of 11 shares.

Prices in the metal trades are strong. Copper is 12 cents, heavy steel rail is $17.50. The Western Wire Consolidation is practically an accomplished fact, but the smaller consolidation of electrical insulated wire interests is said to be hanging fire.

TRADE NOTES & NOVELTIES

Large Sales of The Triumph Electric Co.

WE publish below the large and interesting list of sales made by the Triumph Electric Company, of Cincinnati, O., between March 1 and 15. Their business has been very satisfactory for many months, and since the beginning of the year they have received orders for 95 machines: J. H. Curran, Cincinnati, O., one 5 h. p. elevator motor and controller; County Jail, Louisville, Ky., one 4 k. w. 110-500-volt motor generator; Electrical Supply Co., Madison, Wis., one 5 h. p. 500-volt m. s. motor; Banner Laundry, Cincinnati, O., one 15 k. w. slow speed generator; R. N. Parshall & Co., Owosso, Mich., one 67 h. p. 500-volt moderate speed motor; Langstadt & Crosswell, Neevah, Wis., one 3 k. w. 120-volt slow speed generator; Chicago Heat, Light and Power Co., Chicago, Ill., two 100 k. w. 125-volt moderate speed generators; J. W. Chester, Nashville, Tenn., one 3 k. w. 110-volt slow speed generator; J. E. Caudle, Richmond, Va., one 2 h. p. 220-volt motor; J. I. Hathaway, Los Angeles, Cal., one 5 h. p. 500-volt moderate speed motor and one 7½ h. p. 500-volt moderate speed motor; J. E. Caudle, Richmond, Va., one 5 h. p. 220-volt moderate speed motor; J. H. Curran, Cincinnati, O., three 10 h. p. 500-volt slow speed elevator motors and controllers; Rogers Iron Co., Springfield, O., one ¾ k. w. 110-volt slow speed generator; Cascade Milling Co., Sioux Falls, South Dak., one 5 h. p. bipolar motor; J. E. Caudle, Richmond, Va., one 2 h. p. 220-volt slow speed motor; Krippendorf & Dittman Co., Cincinnati, O., one 1 h. p. 110-volt slow speed motor; J. A. Britenstool, Rochester, N. Y., one cloth cutter; Geo. B. Sickles & Co., Tate, Ga., one 5 h. p. 120-volt moderate speed motor; Peninsular Light and Power Co., Orlando, Fla., one 30 k. w. 250-volt moderate speed generator and one marble switchboard; Hughes Mfg. Co., Hamilton, O., one 30 h. p. 300-volt moderate speed motor.

Large Amount of Railway Material Needed.

Below is given a list of overhead material required for the construction of the Springfield and Southwestern Street Railway Company: 920 wood adjustable brackets, style B, 7½-ft. arm; 1,010 type D malleable iron straight line hangers, 150 type D malleable iron single curve, 90 type D malleable iron double curve, 40 type D malleable iron barn hangers, type D hanger wrenches, 900 type K straight line ears 15" soldered, 20 type K double strain ears 15" soldered, 150 type K feeder ears 15" soldered, 240 type K straight line ears, deep groove; 50 splicing sleeves, 2-0 trolley wire; 180 globe strain insulators, 30 globe strain insulators with clevis, 10 Detroit section insulators, 1,760 feeder wire insulators, 20 Brooklyn strain insulators, 1,760 cross arm braces, 20"; 1,760 cross arm pins, iron; 330 eye bolts, 1½" x 12". Mr. Jesse W. Starr, Hartford, Conn., can be addressed on the subject. While he specifies certain makes of material, he does not limit himself necessarily to that make. He will also require spikes, rail bonds, etc.

The Cross Electrical Company, Buffalo, N. Y.

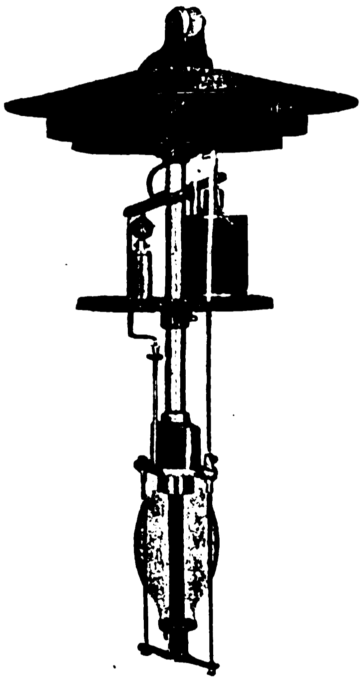
Fred J. Cross, L. Riegel and John Atkins have formed a partnership that will be known as the Cross Electrical Company and have opened a suite of rooms in the Mooney-Brisbane building, where they will carry in stock and handle dynamos, motors, transformers, telephones and a general line of electrical supplies. Mr. Cross, who will act as manager for the company, has had a wide experience in the electrical field and will no doubt with the aid of his able partners, make a success of their new venture. The company also have a department for the refilling of incandescent lamps.

UNIVERSAL FIRE ALARM COMPANY are equipping the buildings and manufacturing establishments of Camden, N. J., with their automatic fire alarm system.

Upton "Midget" Enclosed Arc Lamps to Operate Singly on Constant Potential Circuits.

THE construction and appearance of the Upton Midget lamp to operate singly on constant potential circuits of 220 volts, is identical with the 110-volt constant potential lamp manufactured by the Standard Thermometer and Electric Company, of Peabody, Mass. There is a slight change in the magnet and construction of the clutch rod necessitated by the difference in the current; this is clearly shown in the figure.

The lamp is designed to take from 2 to 3½ amperes, the standard being 2½ amperes, with approximately 150 volts across the arc. The high voltage of the arc makes it very flexible and capable of standing a fluctuation of 50 volts without affecting the light. This makes the lamp especially desirable on 220-volt power circuits of varying loads. It also enables single lamps to be furnished storekeepers for operation independently. The lamp has the same wattage consumption at 2½ amperes as the 110-volt lamp at 5 amperes. It has a very handsome exterior appearance, as have all the lamps manufactured by the above named company.



MECHANISM OF THE UPTON "MIDGET" ENCLOSED ARC LAMP TO OPERATE SINGLY ON CONSTANT POTENTIAL CIRCUITS.

Sprague Electric Co.

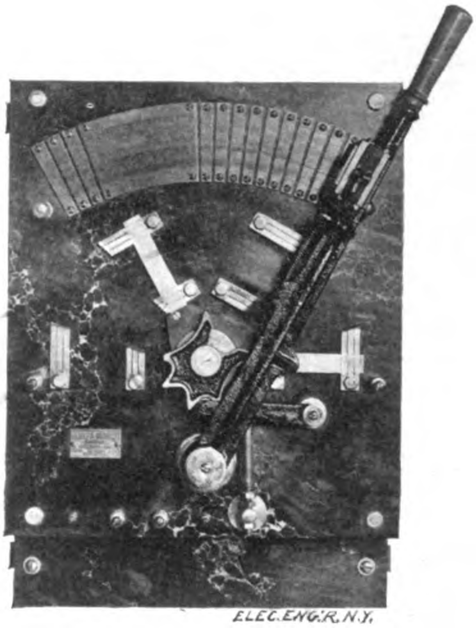
The organization of the Sprague Electric Company, which our readers well know, was formed by the consolidation of the Interior Conduit and Insulation Company and the Sprague Electric Elevator Company, is being rapidly perfected. The offices of the company now occupy practically the whole of three floors in the Commercial Cable building. The company recently secured a suite of rooms in the Marquette building, Chicago, which will be in charge of Mr. Millard B. Kitt and Mr. E. B. Kittle, long identified with the company. Well-known electrical men and houses are being rapidly secured to represent the Sprague Company in various sections of the country, and the organization bids fair to be a remarkably strong one in every way.

An advertising and press bureau is one of the new departments of the Sprague Company, and it has been installed in a suite of rooms on the nineteenth floor of the Commercial Cable building.

EASTERN ELECTRICAL CONSTRUCTION COMPANY, of Philadelphia, has been formed by W. D. Barnard, W. Hoopes, E. M. Jarnall, J. Mustard and G. E. Johnson, with a capital stock of $50,000.

American Rheostat Co.'s Reversible Printing Press Controller.

THE reversible printing press controller, illustrated below, has recently been introduced by the American Rheostat Company, Milwaukee, Wis., and is claimed to possess decided advantages over any similar device now on the market. This controller has a double pole, reversing snap switch, which is operated automatically by the throw of the lever, opening the circuit when the lever is brought to the central position, and closing the circuit when it is moved backward or forward. With this controller, sparking on the contacts is done away with, the parts are easily accessible and renewable, and of first-class material and workmanship. The instrument gives a variation of twelve different speeds on the forward motion and three on the backward motion, allowing the motor to reverse slowly. A large number of these controllers have recently been installed and they are giving the best of satisfaction, as they prevent any possibility of damage to the motor through the carelessness of the operator.



AMERICAN RHEOSTAT CO.'S REVERSIBLE PRINTING PRESS CONTROLLER.

Simplex Friction Tape.

In presenting a tape to the public an advertiser can make no fairer proposition than that of offering to send to any person interested a sample free of expense. This is the offer made by the Western Electric Company in regard to the Simplex friction tape, and upon receipt of an inquiry they will mail a small sample roll of this tape to the address of the person requesting it. The Western Electric Company knows the merit of the tape offered for sale and feels sure from their past experience that when a customer has once tried a sample that he will send in his order for this tape when he is in the market.

Micanite Abroad.

The Mica Insulator Company, whose offices are at New York and Chicago, with a branch at London, Eng., recently received from one of the large builders of electrical machinery abroad orders for over 5,000 "Micanite" segments of a large pattern (many of which were more than 17 inches in length), and from another leading manufacturer of electrical apparatus an order for 2,000 segments, also from one of the leading motor builders an order for 26,000 segments. This volume of business would indicate that the company's "Micanite" segments are meeting with favor among machinery builders. The company claim that their segments are softer and wear down more evenly than mica segments. Therefore, they give better satisfaction.

A sample set of segments for any one of the smaller machines will be furnished free of expense to electrical manufacturers or repair concerns who are desirous of demonstrating the value of the segments.

Sales of Ball Engines.

The new Bellefield Hotel, Pittsburg, Pa., will have its own electric light plant, consisting of three Ball engines, built by the Ball Engine Company, Erie, Pa., direct connected to Westinghouse dynamos. McNeil Bros. of Chicago have recently placed in their building a Ball engine, built by the Ball Engine Company. The engine is direct connected to a Western Electric Company dynamo. The American Bank building, Kansas City, Mo., recently installed an electric plant. Two Ball engines direct connected to Western Electric Company dynamos furnish the power.

Erickson Outlet Insulators.

THE Erickson outlet insulators are now manufactured for use in conjunction with all styles and sizes of conduits for interior wiring installations. Since their introduction two years ago they have steadily gained favor among engineers and enter-

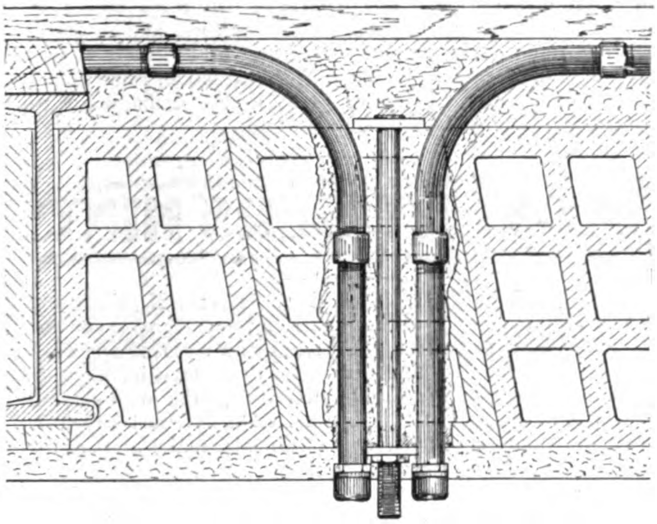


FIG. 1.—METHOD OF INSTALLING ERICKSON'S CEILING OUTLET.

prising contractors, as a device that adds to the safety and completeness of the work in their charge. The insulators are made in substantial form, having a threaded metal member to receive

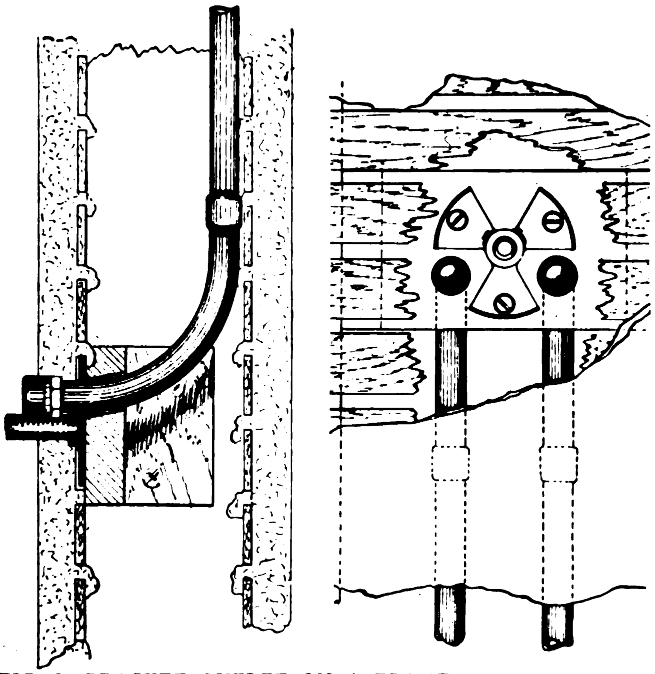


FIG. 2.—BRACKET OUTLET ON A FRAME PARTITION.

the conduit pipe, the outer end being enveloped by an insulation of the highest grade obtainable.

The design of the insulator is such as to admit of its easy installation; standard tools used in connection with conduit work are all that are required to set the insulators securely in place.

The old method of projecting the ends of the conduits at the outlets has been a source of considerable danger, to say nothing of the expense necessary to keep the canopies of fixtures from grounding. The outlet insulators not only prevent the above difficulty, but also provide a smooth insulating finish that enables the wires to be drawn in or out of the conduits with immunity from chafing or cutting of the insulation.

Fig. 1 illustrates the method of installing ceiling outlets in a building constructed with fireproof arches. Fig. 2 shows a

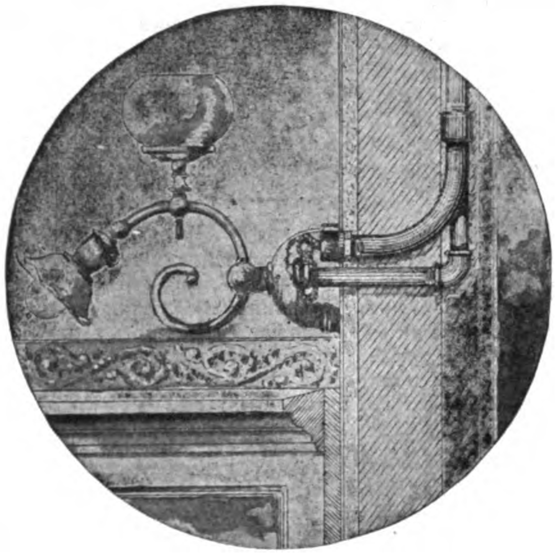


FIG. 3.—EXTERIOR VIEW OF ERICKSON'S INSULATOR.

bracket outlet on a frame partition. Many important buildings have of late been equipped with these outlet insulators, the general verdict being that they made an ideal outlet finish at a minimum cost. The Erickson outlet insulators are handled exclusively by C. S. Knowles, the well-known supply house, No. 7 Arch street, Boston, Mass.

Plant for Chili.

The Westinghouse Electric and Manufacturing Company and Westinghouse, Church, Kerr & Company have just received the contract for the entire equipment of machinery and electrical apparatus for a large electric lighting plant in Chili, being erected at Punta Arenas, the extreme southern end of that country. The buildings for the new station have been completed, and the machinery will be installed at once by Pittsburg machanics.

American Range Finder Co.

The American Range Finder Company has made an assignment to Charles B. Van Nostrand. The company was incorporated in 1888, with a capital stock of $500,000, to manufacture the ingenious range finder, invented by Lieutenant B. A. Fiske, to determine the distance and location of ships at sea. Soon after the company was started the government placed the finder in use on the cruisers Chicago and Baltimore.

Metropolitan Electric Construction.

The Metropolitan Electric Construction Company is now doing all of the installation work of the Sprague Electric Company, an arrangement to that effect having been recently closed. The announcement was made in a striking two-color circular by the Sprague Company, in which circular it was pointed out that the Construction Company would not only contract for installation and maintenance of Sprague machinery, but of any other machinery as well. The offices of the Construction Company, as well as those of the Sprague Company, are in the Commercial Cable building. The officers are W. D. MacQuesten, president and general manager, and Mr. Wallace E. Carver, treasurer.

OWOSSO, MICH., is receiving a new telephone switchboard built by the Detroit Switchboard and Telephone Construction Company, for 300 numbers.

CATALOGUES.

A Modern Gear Plant.

Steel gears and pinions form the subject of a small pamphlet, well illustrated and printed, issued from the press of the General Electric Company, under the title "A Modern Gear Plant." It contains a description of the extensive plant which that company has established at the River Works at Lynn, for the exclusive manufacture of steel gears and pinions, equipping it throughout with the most modern machinery. This pamphlet will be sent on application to any of the company's sales offices, one of which is found in every large city in the United States.

Western Electric 1898 Fan Motor Catalogue.

A very handsome and elaborately illustrated catalogue and price list has just been issued by the Western Electric Company, New York and Chicago, illustrating and giving the prices of their 1898 fan specialties. Fans for direct and alternating current circuits, with variable speeds, for desk and ceiling use, are shown in perspective and section, and show the great variety of these goods manufactured by this company.

H.-C. Direct Current Fans.

The Holtzer-Cabot Electric Company, Brookline, Mass., have issued a very neat catalogue for their fans for the season of 1898. These motors are of the direct current type, spherical in form, all laminated, no outside wires, carbon brushes self-feeding, four-speed switches, grease cups for lubrication, bearings of phosphor bronze. The 12-inch and 16-inch fans are alike in style this year, and are both very handsome. The catalogue gives full details, and copies should be secured at once.

Catalogue of the Joseph Dixon Crucible Co.

The superiority of Dixon's pure flake graphite over oil as a lubricant is set forth in a neat little pamphlet issued by the Joseph Dixon Crucible Company of Jersey City, N. J. Comparative tests of oil and graphite made by Prof. Thurston are presented and show a decided advantage of graphite over oil. The pamphlet contains much valuable information on the subject of lubrication and would prove of interest and value to every central station man and user of machinery.

Catalogue of the National Pipe Bending Co.

The National Pipe Bending Company of New Haven, Conn., set forth in an admirable pamphlet the many advantages possessed by the National feed water heater manufactured by them. This heater has now been sold for over fifteen years, during which time it has come into very general use in all parts of the country and its great efficiency and reliability are to-day as well attested as any other facts in the whole science of engineering. This is due to the simple common-sense theory upon which the heater is planned and the thorough and workmanlike manner in which it is constructed. The record of the company is 800,000 horse power in daily use. The advantage of the heater may be summed up as follows: No inside joints to leak, no straight tubes to leak, no back pressure is possible, no contact of the water with the shell or iron, no chance of grease in the boiler; and economy of coal, space and price. The catalogue is profusely illustrated, showing the various types of heaters and their uses and numerous shapes and styles of coils.

Catalogue of the Ball Engine Company.

A very handsome and unique catalogue has just been issued by the Ball Engine Company, of Erie, Pa. It consists of a folder, on which are printed in crimson and pale green type the many advantages possessed by the Ball engine. A beautiful half-tone cut of the engine printed on white paper is pasted on the middle page of the folder and makes the production both novel and artistic. The folder is enclosed in a greyish cover, on which are embossed the significant words "A Modern Engine." The main advantages of the engine here brought out are the gravity system of oiling, the automatically adjusting valve and the closely regulating, automatic governor.

The Electric Gas Lighting Co.'s Catalogue.

One of the most useful and complete catalogues and price lists of electrical house goods is that of the Electric Gas Lighting Company, of 195 Devonshire street, Boston, Mass. The catalogue contains cuts and prices of every conceivable electrical apparatus for house, line and office use. The typographical work of the catalogue is excellent and the very complete index renders it of great value to every one selling or installing goods manufactured by this company.

An Important New Fan Motor Catalogue.

The Sprague Electric Company, Broad street, New York City, have just published what they claim to be the handsomest catalogue of fan motors ever printed, and they have it now ready for distribution. The catalogue embraces all of their new types of ordinary and ceiling fan motors, and is enclosed in a rich green cover, printed in red and gold, giving it an unusually beautiful effect. We strongly recommend our readers to secure one of these catalogues early, as the demand for them is great, and they will soon be exhausted.

ADVERTISERS' HINTS

McINTOSH, SEYMOUR & CO., Auburn, N. Y., illustrate a horizontal tandem gridiron valve engine arranged for direct connection to a generator. All types and sizes of engines are designed and built by this firm, and they have installed their machines in some of the largest electrical plants in this country.

THE MERRIMAC CHEMICAL CO., 13 Pearl street, Boston, manufacturers of acids and chemicals, make a specialty of battery acids. A card will elicit prices.

WM. J. MURDOCK & CO., 160 Congress street, Boston, build switchboards of all styles. A description of those they furnished the Boston Hospital may be found in another article in this issue.

MONTGOMERY & CO., 105 Fulton street, New York, supply tools for rough and fine work for every trade and at various prices.

THE STANDARD THERMOMETER AND ELECTRIC CO., Peabody, Mass., have introduced an enclosed arc lamp, to burn on 220-volt circuits consuming 2½ amperes at 150 to 160 volts at arc.

JNO. A. ROEBLING'S SONS CO., Trenton, N. J., advertise their bi-metallic wire. As it is claimed, this wire has 35 per cent. more resistance than pure copper wire of the same diameter, and is much cheaper to install.

THE READING ELECTRICAL MFG. CO., 739 Penn street, Reading, Pa., say they can save their customers money on supplies, ammeters and voltmeters and bicycle lamps.

THE WESTINGHOUSE ELECTRIC AND MFG. CO., Pittsburg, Pa., mention a list of apparatus brought out by them as a contribution to science.

THE RIDGWAY DYNAMO AND ENGINE CO., Ridgway, Pa., call attention to the special coils provided in their generators for balancing armature reaction and securing perfect commutation with absolutely fixed brushes.

THE NATIONAL CARBON CO., Cleveland, O., advertise a carbon process cup cell with the carbon element all in one piece.

G. M. ANGIER & CO., 64 Federal street, Boston, Mass., advertise Paragon arc lamps for 110, 220 and 500-volt currents.

C & C ELECTRIC CO., 143 Liberty street, New York, recommend those who are looking for the most modern and most efficient lighting and power apparatus to correspond with them.

THE LYNN INCANDESCENT LAMP CO., Lynn, Mass., offer new "Lynn" incandescent lamps at twenty cents, renewed lamps at fifteen cents, or to renew lamps at twelve cents.

THE SCHNEIDER MFG. CO., Cleveland, O., are ready with their water-motor fans for the '98 season.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., recommend the "Newgard" combined waterproof socket and globe as a protection for lamps exposed to moisture

in breweries, paper mills, packing houses, etc. A sample may be obtained for 60 cents.

K. & W. CO., Pittsfield, Mass., report excellent business in both the "Hardy" incandescent lamp and electrical supplies. Their works are running to their full capacity and the company has a large number of orders on hand.

THE HUNTER FAN AND MOTOR CO., Fulton, N. Y., illustrate their 1898 models of ceiling fans for direct and alternating currents.

THE BEATTIE ZINC WORKS CO., Reading, Mass., are making a special shaped zinc which permits of its complete utilization.

THE SPRAGUE ELECTRIC CO.'S fan motor catalogue is, as they claim, a work of art. It describes all their latest types and models and may be obtained by addressing their press department at 20 Broad street, New York.

THE HOLTZER-CABOT ELECTRIC CO., Brookline, Mass., advertise noiseless, artistic fan motors having four speeds and many other pleasing and economical features.

THE WESTERN ELECTRIC CO., Chicago and New York, advertise a large variety of fan motors to suit all conditions.

A. T. THOMPSON, 26 Bromfield street, Boston, Mass., carries a large stock of optical projection apparatus for photo-engraving, stage lighting, etc., as well as stereopticans, magic lanterns and accessories.

UEHLING, STEINBART & CO., 63 Mulberry street, Newark, N. J., call attention to the saving in fuel that may be effected by the use of the gas composimeter. This instrument was fully described in our last issue.

NEW YORK NOTES.

SPENCER, TRASK & CO., 27 and 29 Pine street, New York, City, have just issued an admirable little pamphlet, illustrated, reviewing the Edison Companies of New York and Brooklyn, from the investor's standpoint. It goes into exhaustive review of the statistics relative to these stable properties and their splendid growth. Copies will be sent to those who may desire.

WESTINGHOUSE ELECTRIC & MFG. CO. have declared a regular quarterly dividend of 1¾ per cent. on the preferred stock, payable April 1.

REGER & ATWATER CO. have been incorporated to deal in mechanical and electrical supplies by A. P. Reger, W. M. Reger, P. A. Reger, M. E. Reger and R. D. Duke.

THE CHERRY ELECTRIC WORKS, of New York, are meeting with well deserved success in the manufacture of their low-priced direct reading ammeters and voltmeters. They have now well introduced these instruments, which are becoming popular on account of their accuracy, combined with extremely moderate cost.

E. G. BERNARD COMPANY, Troy, N. Y., have contract to furnish the Dobler Brewing Company, of Albany, N. Y., with two 60 h. p. direct connected generators, one electric elevator, seven motors and all the outfit necessary for a lighting plant.

ROCHESTER ELECTRIC MOTOR COMPANY, of Rochester, N. Y., has undergone recently some changes in its management. The present officers are: F. C. Kinmel, president; Edw. F. Davison, secretary and treasurer; P. J. McDonald, superintendent. The company have moved from 20 Spring street, to the corner of Mill and Platt, where with increased floor space and new machinery they are in a position to turn out a large quantity of product, and, if possible, better goods.

NIAGARA FALLS, N. Y. The Cataract General Electric Company of New York City, which holds the right to equip the canals of the State with appliances to propel boats by means of electricity, has filed in the office of the Secretary of State a certificate of continuation of its corporate existence for five years, from November 3, 1898. The company was orginally incorporated in 1893, for a period of five years. The certificate is attested by Frank W. Hawley, Charlton T. Lewis, William Mertens, C. P. Vedder, J. S. Bache, Charles Ambrecht and Peter F. Meyer.

BROOKLYN, N. Y. The Queens Borough Electric Light and Power Company has been formed to supply gas and electricity for lighting the streets and houses of New York City and of the Counties of Kings, Queens and Suffolk; capital stock, $250,000. Directors: Van Wyck Rossiter, David H. Valentine, Royal C. Peabody, C. L. Rossiter, and T. S. Williams, Brooklyn; Frank Macgovern, Manhattan; Joseph C. Biglin, Far Rockaway; Isaac M. Sutton, Flushing, and J. Hobart Potter, Jr., Lawrence.

STANDARD ELECTRIC COMPANY has been formed at Binghamton, N. Y., with a capital stock of $5,000, to make and sell electrical and mechanical devices, etc. The directors are C. F. Terhune, Lavelle M. Blanding and Robert E. Prince. The firm is a consolidation of the firms of Lavelle M. Blanding and Roloson & Tileston.

WAPPLER ELECTRIC CONTROLLER COMPANY, of New York City, has been formed with a capital stock of $5,000 by R. H. Wappler, J. C. F. Jacoby and Chas. Fayer.

HUDSON, N. Y.—A bill is before the State Legislature to incorporate the Jansens Kil Electric Power Company, of Hudson, with W. A. Harder, Jr., of Hudson, and P. M. Harder and C. N. Harder, of Philmont, interested. The capital is $100,000. The plan is to utilize electrically the power on the Roeliff-Jansens-Kil in the counties of Columbia and Dutchess.

THE DIESEL MOTOR, which has attracted such universal attention as a new type of engine is to be shown in operation at the Electrical Exhibition, Madison Square Garden, in May. It is to be shown in October at the exhibition of the Massachusetts Charitable Mechanics' Association in Boston.

PAN-AMERICAN EXPOSITION.—Owing to the troubled condition of our international affairs, and the unwillingness of Congress to lessen the amount available for defense appropriations by a grant for the Exposition at Niagara just now, the management has postponed the affair until 1900 or even a year later. Electrical exhibitors who proposed to show there next year are now concentrating their effort on the big show to be held at Madison Square Garden this May.

WESTERN NOTES

WESTERN ELECTRIC CO. is sending out a circular of the Star Soldering Stick. This soldering stick is a complete substitute for acids, resin and soldering salts and will not corrode metals.

MISSOURI VALLEY ELECTRIC LIGHT COMPANY, in writing of the Lakon transformer, states that they have had a number of them in circuit for two years, which have given excellent service. Wherever these transformers are used, the purchasers are well satisfied. The manufacturers of the Lakon transformer have recently completed a large three-story brick factory, which is equipped with the very best facilities, to enable them to manufacture transformers to the best possible advantage. Their laboratory is most complete, being fitted up with a full complement of instruments with which to make exhaustive transformer tests, and thus they are assured of the quality of the transformers before they are shipped to purchasers. These transformers are handled by the Western Electric Company, of Chicago and New York.

IOWA.—The State Senate has passed a bill authorizing cities to purchase, construct and operate telephone exchanges. Its chief object is said to be to permit Des Moines to acquire the Mutual Telephone Company, of that city, an independent "unremunerative property."

THE ARMOUR ELEVATOR, Chicago, has recently started up a Ball engine, built by the Ball Engine Company, Erie, Pa., for electric purposes. The Eden Musee, of Chicago, has also recently installed for lighting an Erie Ball engine.

BAY CITY, MICH.—The Valley Telephone Company has ordered 1,500 telephones, etc., from the American Electric Telephone Company, of Chicago, and the first of these will be placed in West Bay City.

EAU CLAIRE, WIS.—R. E. Rast, receiver of the National Electric Manufacturing Company, has been ordered by the Court to turn over all books and vouchers to the Court, as the result of a petition for a general overhauling of the receivership. There is about $100,000 involved.

THE WESTERN ELECTRIC COMPANY in advertising the Simplex tape offers to send samples free to those who desire to use it, stating that they need not purchase until they are convinced of its superior merits.

THE W. E. NON-SPARKING BRUSHES have proven, it

is said, one of the best preventives of the disastrous sparking which so frequently interferes in the successful operation of a dynamo. They are now being used in almost every city in the United States. A circular giving regular stock sizes and price lists of these brushes will be mailed by the Western Electric Company to any one desiring information in regard to them.

MR. W. R. GARTON, 414 Ashland Block, Chicago, will act as the Western representative for W. E. Kline & Company, 123 Liberty street, New York, for the sale of their miniature and decorative incandescent lamps.

SAULT STE. MARIE.—The Edison Sault Company is to spend $75,000 in improvements this year.

MR. W. O. KNUDSEN has opened a branch office at Cleveland, O., in behalf of the Electric Storage Battery Company, and has his quarters at 914 New England Building that city. He will have the greater part of Ohio and Western Pennsylvania and part of New York State in his territory.

SOUTHERN NOTES

BRISTOL GAS AND ELECTRIC LIGHT COMPANY, of Bristol, Tenn., has recently installed a 200 h. p. Ball cross compound condensing engine, built by the Ball Engine Company, Erie, Pa.

HAGERSTOWN, MD., has voted through its city council $60,000 for a municipal plant, and has asked estimates and plans from the Westinghouse Company.

WHEELER ELECTRIC MANUFACTURING COMPANY, Chattanooga, Tenn., is now, it reports, running full on the Wheeler dental engines, and has a lot of orders on hand.

BARDEN-SHEETS ELECTRIC CONSTRUCTION COMPANY, of Houston, Tex., has recently filed a chattel mortgage for the benefit of creditors to the amount of $3,034, including Washburn & Moen, Electric Appliance Company, General Incandescent Arc Light Company, Central Electric Company, New York and Ohio Company, Interior Conduit and Insulation Company, Western Electric Company.

PHILADELPHIA NOTES

WASHINGTON CARBON COMPANY are doing a rushing business with their enclosed arc light carbons for both alternating and direct current. Several arc lamp manufacturers have adopted them for exclusive use.

MR. MARTIN E. HERSHEY, the well-known manager of the Foundry and Machine Works, East Harrisburg, Pa., has tendered his resignation. He has been connected with this concern for more than 15 years, during which time its product has become celebrated throughout the world. Mr. Hershey is a practical machinist, draftsman and thorough man of business.

KEYSTONE ELEC. INSTRUMENT CO., Ninth street and Montgomery avenue, Philadelphia, have appointed Mr. W. R. Garton their Western representative, with headquarters at 414 Ashland Block, Chicago.

NEW ENGLAND NOTES

MORSE WOOL TREATING CO. have just completed at Norton, Mass., an extensive plant for purifying wool. The buildings are of a very substantial character, entirely fireproof, and were designed and built by The Berlin Iron Bridge Company, of East Berlin, Conn. The floors throughout the whole plant are of beams and corrugated iron arches, to carry the excessive loads common to warehouse construction. The roofs are of the well known Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

HOLYOKE, MASS. The city and the local company cannot agree as to the price of the private plant, under the terms of the municipal ownership act, and will take the matter to the courts for settlement.

FOREIGN NOTES

CANADIAN PACIFIC RAILWAY is now experimenting with car lighting by means of a generator placed on the axle.

MEXICAN TELEPHONE COMPANY, of Mexico City, has been making a number of improvements in its service, changing over to metallic circuits, and has bought a quantity of cables, etc., from the Western Electric Company.

TORONTO, CAN., is discussing a double track elevated road system to be built by the Toronto Elevated Railway Company.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. APRIL 7, 1898. No. 518.

Electrical Transmission in Tanneries.

A FIELD into which the electric motor has been quietly entering the last few years, and about which very little has been said publicly, is that of tannery work. It will therefore surprise many to learn of the extent of electric transmission work in these places. That the plan of transmitting power by the means of wires and electric motors should recommend itself to tannery engineers is not surprising, however, in view of the fact that the machinery in a tannery which is arranged for the most convenient handling of materials is necessarily scattered over a large area. A little power is wanted in one place, a little in another, and so on. To transmit power with shafting means either an immense amount of shafting or an inconvenient arrangement of the plant to accommodate the power transmission.

To the Northern Electrical Manufacturing Company, of Madison, Wis., is due the credit of being the first to fully appreciate the needs of the tanners of America for electric transmission, and to this company belongs the credit of being the first to fully equip with electric drive, including dynamos and motors, the first entirely electrically equipped tannery in the world. The engineers of the Northern Company have for some years back made a careful study of machinery used in the tannery trade, and have designed, built and placed upon the market a full line of enclosed motors built at special speeds for direct connection, so far as possible, to the tanners' machines.

One of the features of Milwaukee is the large number of tanneries operating there. The reason for the location of so many tanneries in that city is its nearness to the Wisconsin forests, which furnish the necessary hemlock bark, combined with its direct communication with the large stockyards and packing house centres of the West. The largest concern of the kind in the city and the first one to go extensively into electric power transmission was the Pfister & Vogel Leather Company, of which Mr. C. P. Bossert is the mechanical engineer. The economy this large corporation has found by the use of electric transmission is best shown by the extent to which it is using it in place of the old method of shaft and belt drive. Like many another concern, the Pfister & Vogel Leather Company was drawn into electric power transmission by an extension of its electric lighting plants to run a few motors in distant departments. The company have three tanneries at Milwaukee, all of which employ electric transmission as far as they were able to supplant shafting with it, and they also have a sole leather tannery at Cheboygan, Mich., which is now being equipped electrically throughout. The newest and most extensive of the three located in Milwaukee is the Bay View tannery, which covers about ten acres of ground. It can be imagined how much shafting and belting would be required to deliver power over this area by mechanical transmission. The generating plant at this tannery consists at present of a 100 k. w. generator belted from a shaft driven by the main engine. This engine was put in before electric transmission was thought of, and drives that part of the tannery adjacent to the engine room by means of shafting in addition to driving the dynamos. There is also being installed in this engine room a 60 k. w. direct connected Northern generator. The voltage employed is 250 to 240 volts at the switchboard. For lighting purposes three 80-volt lamps are run in series, as this answers the requirements around a tannery very well. From the marble switchboard, which is the work of Julius Andrae & Sons Company, Milwaukee, Wis., the current is distributed through the various parts of the plant by feeders to centres of distribution.

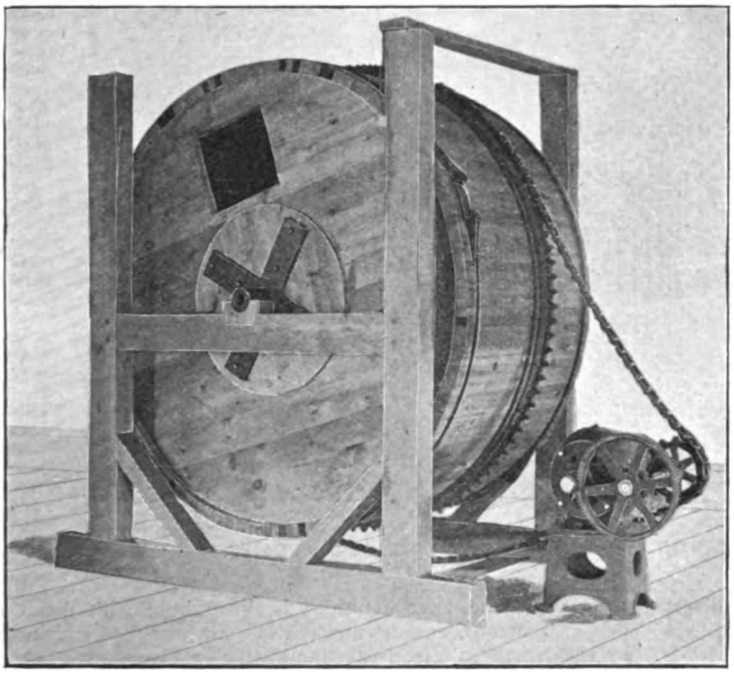


FIG. 1.—NORTHERN STEEL MOTOR, DRIVING RE-TANNING OR STUFFING WHEEL. SPEED, 18 R. P. M.

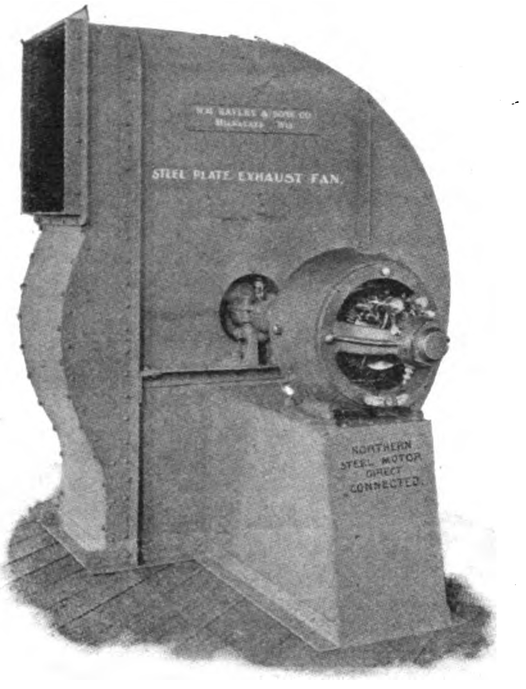


FIG. 6.—LEATHER VENTILATING BLOWER WITH DIRECT CONNECTED MOTOR.

The fluctuations of the motor load in this tannery are not very great, although they are rapid within a small range, as shown by the station ammeter. Thus, at the time of the writer's visit, the load was varying rapidly between 400 and 450 amperes, but rarely went above or below those limits.

Distributed over the plant are motors as follows: One 15 h. p., driving leach house pumping machinery; one 40 h. p., driving sole leather finishing department; one electric elevator motor worm geared to the winding drum; two 18½ h. p. motors direct connected to fleshing machines; one 40 h. p. motor, driving paddles and wash wheels; one 5 h. p. motor, belted to a leather press; one 10 h. p. motor, belted to wash wheels and pumps; three 7½ h. p. motors, each direct connected to a tanning drum; one small motor, driving a portable device for running hides from piles into the lime vats; one 5 h. p. motor, direct geared

to a triplex water pump and provided with a device whereby it is automatically started and stopped by a float in a tank which operates the rheostat by means of compressed air; one 40 h. p. motor, running the shavers and splitters and scouring departments, which departments have a capacity of 400 sides of harness leather per day; one 7½ h. p. motor, driving the line shaft to the jacks in the blackening room; one 5 h. p. motor, driving the finishing room jacks; one 18 h. p. motor, driving the stuffing department; one 5 h. p. motor, driving the sole cutting department. This completes the present electrical equipment of the tannery at Bay View.

The next plant in order from the electrical engineer's standpoint, will be the "Menominee," at Oregon street and First avenue, where are also the Pfister & Vogel main offices. This is an older plant and the work is more concentrated than at Bay View. The generators at this place are also belted from a line shaft, from which a part of the tannery is driven, as the electric power transmission here is a direct outgrowth of the lighting system. For the same reason 110 volts is the pressure employed. There are two generators, one 60 k. w. and one 35 k. w. In this tannery, as in the Bay View tannery, the motors are applied to the various driven machines with particular reference to the habits of the plant and economy in operation, that is to say, some of the heavier machines are operated by direct connection of motor to each machine separately, while others of the lighter running machines are arranged in groups according to the character of work they have to do, each group being driven from a short line shaft by one motor attached to said shaft. The great advantage of direct drive is shown very forcibly in the case of fleshing machines, which require heavy power at times and which always have been troubled with slippage of belts, thus retarding speed and causing not only loss of time, but an imperfect performance by the flesher. By the use of direct connection to this machine a constant speed is maintained and a considerable increase in daily output effected.

At this "Menominee" tannery the following motors are in service: Two 15 h. p. motors, driving each three bark hoists or conveyors; one 5 h. p., driving the experimental laboratory tannery; one 40 h. p. motor, running a six-story currier shop; one 15 h. p. motor, running the currier shop elevator; one special slow speed 10 h. p., direct connected to belt knife splitting machine; one 25 h. p., direct connected to fleshing machine; one 35 h. p., running eight small tanning drums; one special direct connected motor, running a 42-inch ventilating fan; one motor, driving a 36-inch ventilating fan; one 40 h. p. motor, to take the place of a steam engine in case of emergencies.

At the "Island Tannery" of the Pfister & Vogel Leather Company there is a small but economically important transmission. In the engine room, driven from the shaft, is a 45 k. w. 110-volt generator; 400 feet away is a 40 h. p. motor, driving a department and making a great saving over what would be necessary to drive a line shaft that length.

This company is now engaged in electrically equipping its sole leather tannery at Cheboygan, Mich. The Northern Electrical Manufacturing Company has the contract for the electrical apparatus and it is now being put in. The generator will be 75 k. w., 240 volts, and motors will be distributed as follows: One 10 h. p. motor, to run machine shop; one 10 h. p. motor, running carpenter shop; one 30 h. p. motor, driving leach house and pumps; one 25 h. p. motor, running wash house; one 20 h. p. motor, running sole leather finishing department; one 5 h. p. motor, driving an air compressor 1,000 feet from the engine room. It is also expected to put in some kind of an electric tramway for carrying goods around the tannery.

In addition to the Pfister & Vogel tanneries at Milwaukee a number of other Milwaukee tanners have adopted electric drive to a greater or less extent, according to their needs. Notably among these is A. F. Gallun & Sons and the Western Leather Company. The latter have recently erected a large addition to their plant and have equipped it throughout with direct connected dynamos, engines and motors, all furnished and installed by the Northern Electrical Manufacturing Company.

A number of tanners outside of Wisconsin have also adopted electric drive. The largest and most complete electrically equipped tannery in the United States is that of E. C. Fisher & Co., Salamanca, N. Y., the entire equipment of which was designed by the Northern Electrical Manufacturing Company, and all of the electrical machinery was built and installed by them. The plant is operated by two 75 k. w. direct connected dynamos and one 40 k. w., with about 50 motors, the majority of which are direct connected. The Northern Company has also installed electrical equipments for several other Eastern tanners.

The accompanying illustrations show the methods practiced by the Northern Electrical Manufacturing Company for equipping various tannery machines, and the purposes of said machines, are as follows:

Fig. 1 represents a stuffing wheel, into which the leather is put at a certain stage and mixed with grease and steam. The hides are revolved in this a certain number of moments one way and then the drum is reversed and run again in the opposite direction, thus completely filling the leather with oil and at the same time untangling it. Fig. 2 is a large Vaughn fleshing machine, direct connected to special Northern motor. The pur-

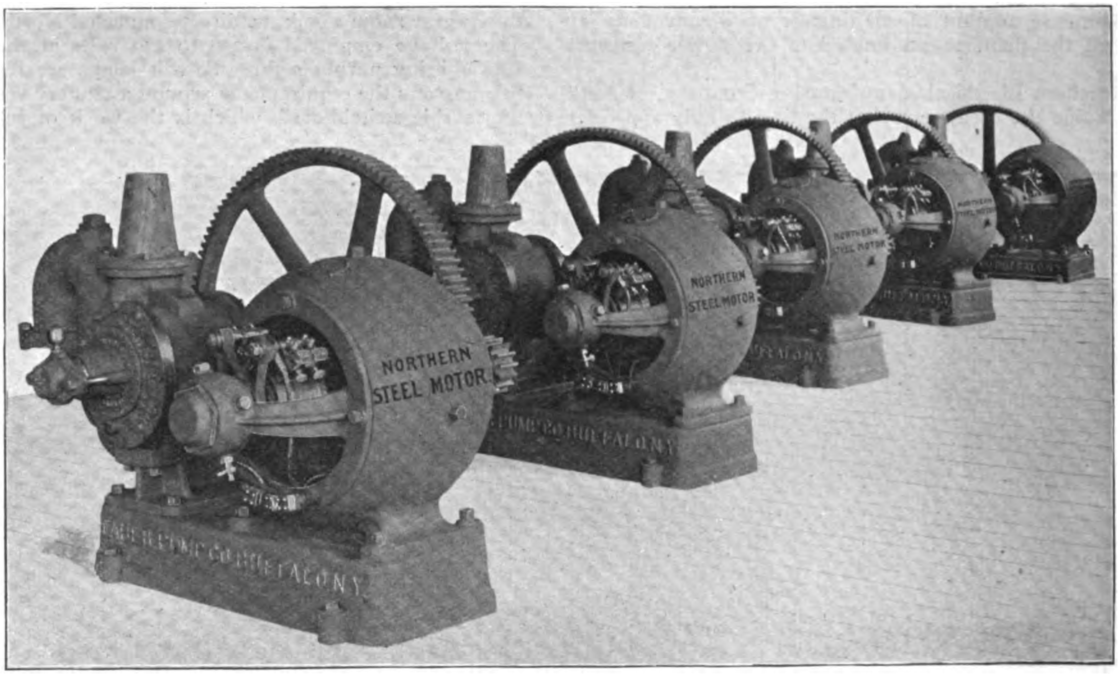


FIG. 7.—NORTHERN MOTORS DRIVING A GANG OF TABER LIQUOR PUMPS.

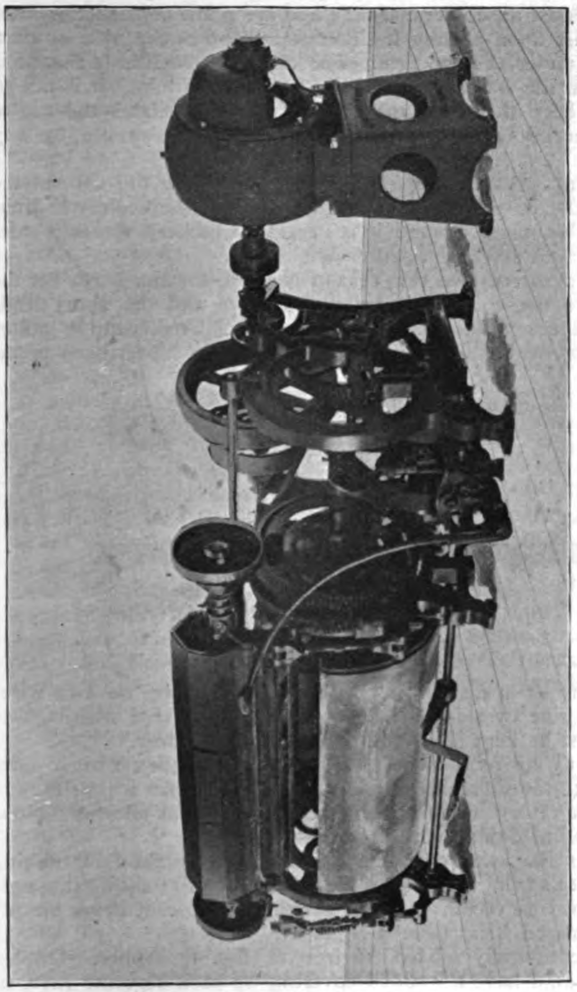


FIG. 2.—NORTHERN STEEL ENCLOSED MOTOR, DIRECT CONNECTED TO LARGE VAUGHN FLESHING MACHINE.

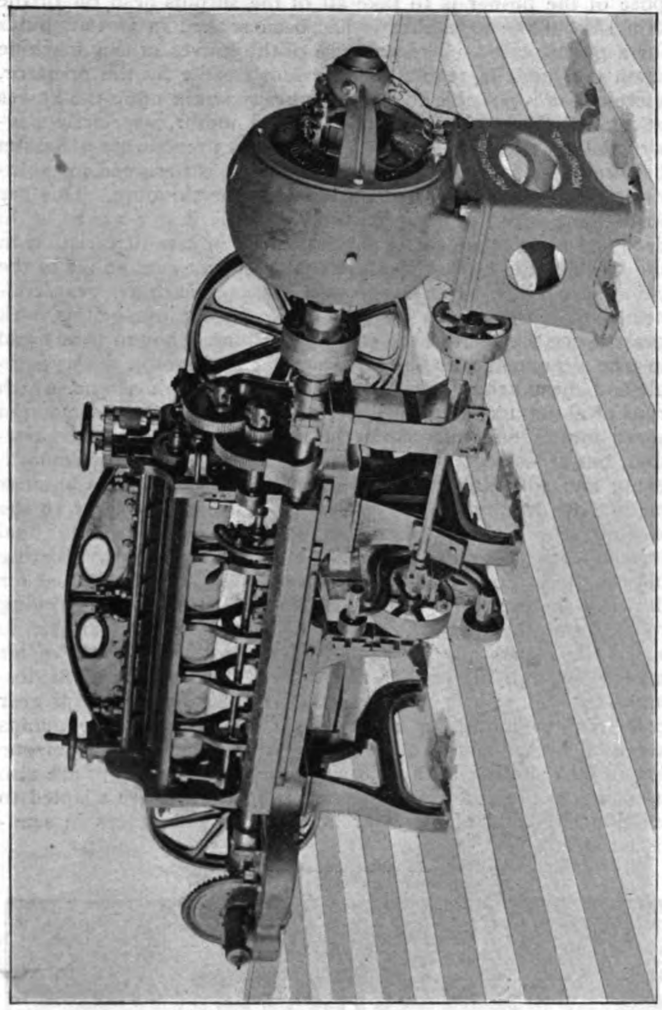


FIG. 3.—NORTHERN STEEL MOTOR, DIRECT CONNECTED TO BASSETT BELT KNIFE SPLITTING MACHINE.

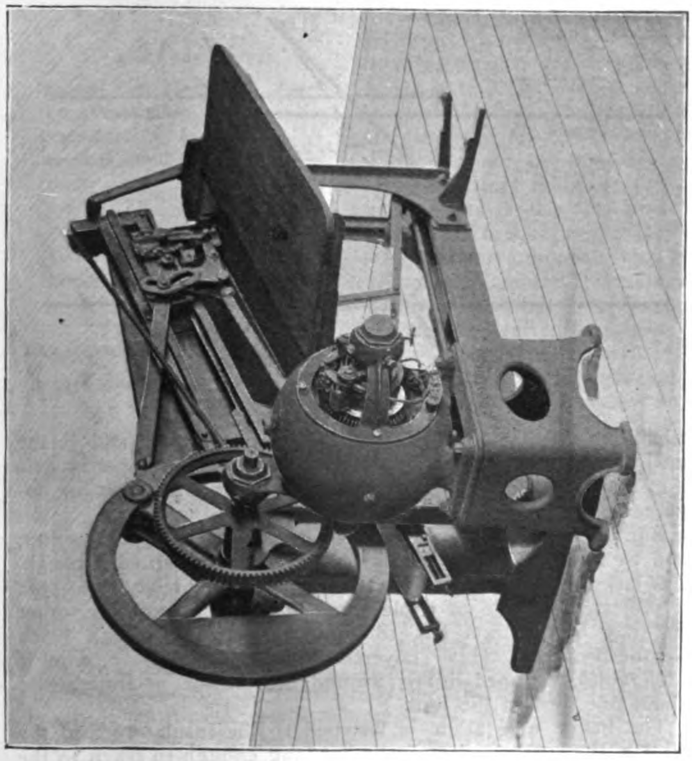


FIG. 4.—NORTHERN STEEL MOTOR, VARIABLE SPEED ATTACHMENT, DRIVING BAKER STAKING MACHINE.

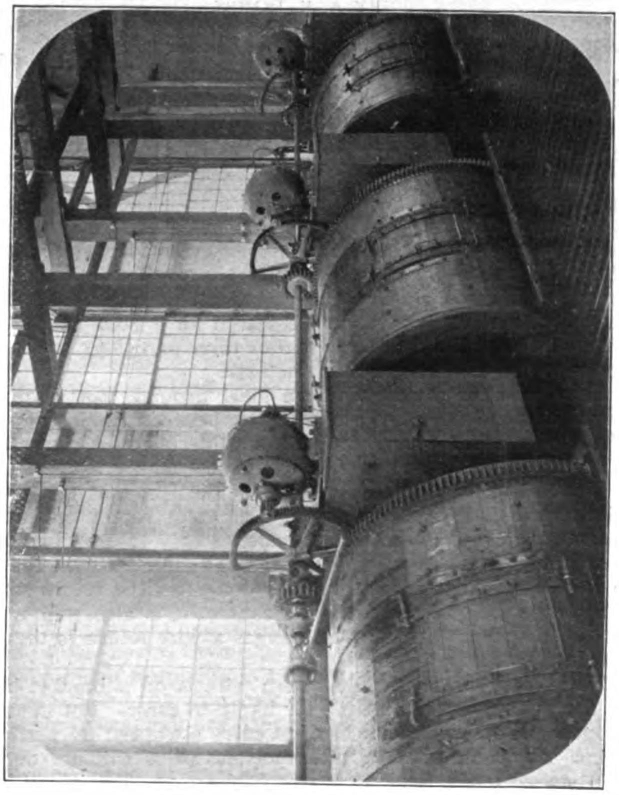


FIG. 5.—TAN DRUMS ELECTRICALLY DRIVEN BY NORTHERN MOTORS.

pose of the flesher is to take all of the surplus flesh off of the skin side of the hide after it has been soaked in various fluids for a given period. The pressure of the knives of this machine upon the hides is regulated by a foot treadle by the operator, therefore it is possible to put very heavy strain upon the knives at times and requires a very powerful motor, especially constructed, to take care of this strain. Fig. 3 represents a Bassett belt knife leather splitting machine, which is designed for splitting thick hides into two or three, also for skinning. This has to be done with the greatest nicety and the motor has to be so designed as to take care of varying speed in case of variation in the stock of the leather in order that there may be no jar in the cut of the knife. Fig. 4 shows a staking machine, gear connected to Northern back gear motor. By the use of this back gear device the shaft of the staking machine is bound firmly and in true alignment with the armature shaft of motor, a very simple and cheap arrangement, whereby the staking machine, which runs at about 100, is propelled with a moderate priced medium speed motor, effecting about the same result as direct connection, but at less cost. The staking machine is used for smoothening and softening out the leather. Fig. 5 illustrates another method of driving tan drums, which are used similarly to the stuffing wheel, except that they are filled with tanning fluid instead of with grease. In Fig. 6 is illustrated a ventilating blower direct connected to Northern motor. This is used for drawing the air through the leather as it hangs in the drying rooms, and the motor is so constructed as to be variable in speed, thus enabling the tanner to control the volume of air moved through his leather and thus control the speed of drying at his will. Fig. 7 shows a gang of Taber liquor pumps gear connected to motor, all mounted on one base. These pumps are used by tanners in pumping their tanning fluids from one location to another in their leach houses. These pumps are also used in glucose factories and soap factories and are adapted to moving any kind of liquid or heavy soapy substances in semi-liquid form.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—IV.

BY A. E. DOBBS.

LINES AND CIRCUITS.

IN exchanges of less than 1,000 subscribers metallic circuits are not necessary, a common return answering every practical purpose.

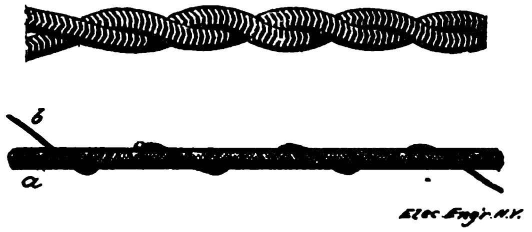
In some small country towns, grounded lines will answer, but a return wire is generally preferable, for, with lines grounded to gas and water pipes and driven rods, the resistance of the "ground" and therefore of the line is a very uncertain quantity. Rods especially are a nuisance in this regard. The author remembers cases where telephones, even grounded in the bottom of a well, had their talking qualities improved 100 per cent. by being connected on a direct return to the office. Then there is no working time saved if, in the search for a good ground, the wireman has to bore through two or three partitions or through floors to the cellar, as is often the case.

Even where a water pipe, an ideal ground, can always be found electrolysis will often be set up between the lead or iron of the pipe and the copper wire, for soldering such connections in private houses is not feasible, and such connections need more or less inspection, to say nothing of the fact that the ground wire running, as it does, through different rooms or through cellars, is often broken. It is almost as easy to drop two wires from a pole line as one, then put a single hole through the wall or window casing and the work is done, and the return service can always be relied upon. Of course, it is also well understood that where a trolley line exists a wire return is the only satisfactory one.

The proper place for the return wire is on a bracket below all the arms that the pole is ever likely to carry. For example, suppose that the line may have to carry six arms; by putting it below where the sixth would come the wires will not only be well spread out in making house connections, but it will serve to protect the line against too close familiarity on the part of other companies and hold a clear right of way for these six arms against all comers. Still there are good construction men who insist upon putting it either at the top of the pole or on a bracket under the top arm. The objection to this is that it is always in the way and in making drops to buildings it is not so easy to keep the wires apart, and often necessitates the use of porcelain knobs on the arm, which is not desirable by any means.

The only reason ever heard given for having the wire at the top of the pole is that in neighborhoods where electric light and trolley wires abound it is necessary to keep the two sides of the circuit as close together as possible.

We fail to see that this reason is valid, for the wires on the poles are not free from trolley influence and the short leads to the house connections, if carefully insulated, cannot gather up a great deal of noise, and if the lead to the subscriber's premises is any great distance from the main pole line, the two wires will run side by side anyhow, and unless insulated wire is used they must be kept far enough apart to keep "clear."



FIGS. 11 AND 12.

In many towns it is best to use twin or duplex wire in connecting to the subscriber's premises, but even then it is as easy to catch the return wire on one part of the pole as another. Now, a word as to duplex wire.

This is the most convenient and sightly method of making connections from the pole to the house. Fig. 11 shows the style of duplex wire commonly used for this purpose, it being simply two insulated wires twisted together.

It is commonly of No. 16 iron or No. 14 copper. Duplex wires should have a braided covering on each separate wire, as plain rubber covered wire, often used for this purpose, means constant trouble, except, perhaps, in offices where it is not exposed to the weather and can be constantly inspected.

The style shown in Fig. 11 is used almost entirely by some telephone companies in making house connections, and is the only kind to use in going through trees, but it frequently gets into trouble from the wires chafing each other and coming together.

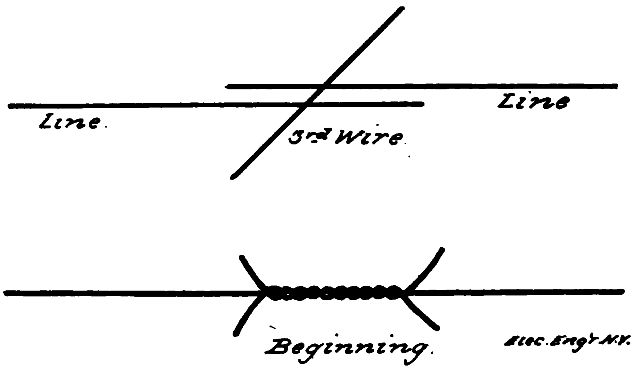


FIG. 13.

Fig. 12 shows a form used with great success by the writer, and we have yet to find the first one chafed or burned through. The large wire (a) is simply a No. 14 iron wire, or No. 12 copper if preferred, double or triple, braided weatherproof; the other (b) may be common No. 18 annunciator wire (though black weatherproof or rubber covered and braided No. 18 wire is preferable), wrapped lightly around the outside, at the rate of about one turn to the foot.

The heavy wire alone is fastened to the insulators and the ends of the smaller wire can be left long enough to reach to the instrument without a joint and to reach the line wire at the other end, leaving that side of the line free from joints. Two

men can make one of these in a few minutes. The advantage in using this latter form lies in the fact that the smaller wire, lying lightly outside the other, being drawn only tight enough to keep it from sagging, does not chafe or wear the insulation.

The Simplex Company of Boston advertised something like this some years ago, but with this difference, that the centre wire was copper while the outside one was steel. I am inclined to think that the steel wire on the outside, though theoretically better, would be more troublesome in practice, on account of chafing through, but having never seen the wire, of course, I can't say.

But to come back to the subject of the common return wire. This should generally be of copper, though sometimes it is desirable to use iron wire to stiffen the pole line, but where iron is used have nothing smaller than No. 8 for leads carrying not in excess of 20 wires, while for leads carrying not in excess of 35 wires two No. 8 or one No. 6 will do. If two iron wires are used keep them separate, distribute the load as near equally as possible on each, run them side by side and transpose every few poles. In this way cross talk will be reduced to a minimum. Note: If iron wire is used to stiffen the line extra heavy brackets will have to be used and at least one lag screw instead of nails to fasten them on. But, still, its superior conductivity and absence of self induction put copper away ahead of iron for this purpose.

All joints should be carefully made, and in order to reduce resistance to the lowest possible point, soldered. It is true that copper joints known as the "3-wire" splice show a very low resistance, being only from .004 to .012 of an ohm (see Electrical Engineer, November 18, 1897). But a little carelessness may increase this resistance and even one extra ohm may increase the cross talk very materially.

In soldering copper use a heavy iron or a blow torch with a small concentrated flame and solder only in the centre of the twist, and do not leave the heat on any longer than necessary, and do not heat outside the joint, as heat will soften and weaken the line. Thus a joint can be made that is electrically and mechanically perfect.

Soldering is not necessary in the drop from the lead to the subscriber, nor is it necessary to solder wire smaller than No. 10 B. & S. All copper lines should be made with what is known among linemen as the "3-wire" splice. This is made by splicing in an extra piece of wire, as shown in Fig. 13, after which it is finished the same as any other twist joint. This is much stronger and better than the ordinary telegraph splice.

Steam Railway Use of the Telephone.

CALLS.

General Office, Cleveland,	——
Local Freight Office, "	—— -
Yard Office, "	—— - -
Brooklyn Depot,	- ——
Lester "	- - ——
Grafton "	- -
Elyria "	- - -
Lorain "	—— ——
Lorain Shops,	—— —— ——

NOTICE.

Take down Receiver and ascertain whether line is in use BEFORE RINGING.

F. E. NOW,
Sup't Telegraph.

THE Cleveland, Lorain and Wheeling Railway Company, a great coal carrying road in Eastern Ohio, of which Mr. F. E. Now is superintendent of telegraph, has installed and is now operating two telephone circuits, the length of each being over fifty miles, on different parts of its road. Mr. Now was one of the first superintendents of telegraph to appreciate the great value of telephonic communication, in addition to telegraphic service, between offices, and that his company thinks well of his ideas is shown by the fact that two circuits have been installed so far.

The circuit which Mr. Now last built reaches along the road from the general offices at Cleveland to the great coal wharves of the company at Lorain, a distance of fifty-four miles, with seven intermediate stations bridged in on the line. Leading out from Cleveland the line takes two conductors in the underground cables of the Cleveland Telephone Company for a distance of about two miles; the rest of the way the line extends overhead. That part of the line which is overhead is placed on poles of the Western Union Telegraph Company, and consists of two bimetallic wires of size No. 12, Brown & Sharpe gauge. The wires are attached to the cross-arms by means of porcelain knobs and are transposed every one-seventh mile, or thereabouts. The apparatus used is leased from licensees of the American Bell Telephone Company, the Cleveland Telephone Company and the Central Union Telephone Company, the railway line running through the territory of each licensed company. The instruments are of the standard "Bell" type, "Blake" transmitters being used.

It will be readily seen that the conditions under which this circuit operates are rather severe, because of the number of stations on the line, nine in all, and the fact that the wires, for the greater part of the way, are in close proximity to many heavy telegraph lines. There is, however, practically no induction on the telephone wires from the telegraph lines, this because of the number of transpositions in the line, of the high grade of construction and of the use of bimetallic wire, which wire is rapidly becoming a standard for first-class telephone lines. In a few words, the workings of this circuit may be said to be highly satisfactory, in fact, no better telephonic circuit can be found.

The Cleveland, Lorain and Wheeling Railway Company does not use its telephone lines for dispatching trains, but rather for the hundred and one important matters which naturally come up in conducting a busy road. The telephone and the telegraph each has its own sphere; if anything, the telephone has reduced the amount of correspondence between offices.

A most ingenious, ingenious because it is remarkably simple,

MR. F. E. NOW.
(Supt. of Telegraphs, Cleveland, Lorain & Wheeling Railway Co.)

system of calls, or signals, has been devised by Mr. Now, this being necessary because all stations are bridged in on the line, and when one office calls another the bells at all stations are actuated. The object in view, of course, when arranging this system of calls was to have each signal so that it would be readily distinguished from all others, and, from the card shown above, which is placed at all stations, it will be seen that this has been accomplished.

Mr. Now has spent many years in telegraphy and has devoted much time and study to general electrical subjects. The results of his study are apparent in several important inventions relating to the telegraph, one in particular, his invention for simplifying office equipment, having been most favorably received. Though his work in telephony is of comparatively recent date, the way in which he has constructed and equipped his telephone lines shows a thorough understanding of the subject. In addition to his duties as superintendent of telegraph, Mr. Now is also purchasing agent of the Cleveland, Lorain and Wheeling Railway Company.

MECHANICAL

Successful Tests of the Wright Wave Motor.

NO one who has ever studied the wave movement of the ocean has failed to realize that millions of horse power were being daily wasted upon the beach along the various coasts of the country. The harnessing of this mighty power of the ocean waves and transforming it into a steady, constant, mechanical power available to drive the machinery of the world, has been the dream of the inventors of the century. The great problem has been how to change the unsteady, intermittent power of the waves into a steady, constant power required for the operating of machinery, and at the same time to prevent destruction of the plant during periods of storm. To accomplish this purpose many devices have been invented year after year, but most of them have proved utter failures, and have never passed beyond the experimental stage. The Wright wave motor, which we describe and illustrate below, is one of the recent promising attempts. As a matter of history, it may be interesting to state that the Los Angeles Ocean Power Company built its first experimental wharf in January, 1897, and public tests were made soon after in the presence of many witnesses. Encouraged by the results of these tests, the company was organized in March the same year. Soon after, the company expended $2,000 to extend and enlarge the plant already commenced. The wharf, a good metallic structure, shown in Fig. 1, was extended out to about 350 feet into the ocean and 26 feet in width. At the outer end of this wharf, a wave motor plant was installed, consisting of three floats and other necessary machinery to store, equalize and regulate the power obtained.

This plant has been subjected to a working test of over thirty successive days, during which time, from November 16 to December 16, 1897, very severe weather and rough seas were encountered, storms which wrecked a vessel within sight of the wave motor plant, and did other damage. The results of these tests are given in the following table:

RESULTS OF PUBLIC TESTS MADE WITH THE WRIGHT WAVE MOTOR AT POTENCIA, CAL.

DATE.	No. of waves per min.	Piston travel in feet per minute.	Average pressure, pounds per sq. inch	Cubic feet water per minute discharged per float.	Horse power per float developed at Pelton wheel.	No. of electric lights.	Condition of sea and weather.
December 1..	8	12.5	150	3.8	2.3	9	Stormy.
December 2..	7	14	152	3.9	2.5	9	Rough.
December 3..	4	16	155	3.7	2.3	9	Calm.
December 4..	5	14.5	155	4	2.9	9	Calm.
December 5..	4	15.7	160	3.8	3	9	Calm.
December 6..	4	17.4	165	4.1	3.4	9	Calm.
December 7..	3	12.9	160	3.9	2.6	9	Calm.
December 8..	6	16.3	185	4.3	3	9	Calm.
December 9..	3	16.6	175	4.4	2.9	9	Calm.
December 10..	8	18	195	4.6	3.5	9	Lt. wind
December 11..	6	14.3	185	3.5	2.7	9	Calm.
December 12..	5	17	155	4	2.5	9	Windy.
December 13..	4	15	160	3.4	2.3	9	Choppy.
December 14..	6	18½	195	4.25	3.3	9	Stormy
December 15..	7	15.5	180	3.8	2.5	9	Calm.
December 16..	6	14	175	3.2	2.3	9	Calm.

The electric lights were merely to demonstrate steadiness of power. Proportional variations were due to varying conditions under which the motor was tried. Variations in pressure were due to changes in weight of floats and size of nozzles, and amount of water pumped, etc.

The motor is operated by a series of floats operatively connected with vertical hydraulic compressors, or pump cylinders which are in turn connected with a large storage pressure tank of heavy steel. The rising and falling movement of the waves raises and lowers these floats, and in doing so, pumps fresh water from a reservoir into the pump cylinders and forces it into the storage pressure tank, where by compressing the air contained in the tank the water becomes subjected to a very heavy pressure, under which pressure it is driven out of the tank through a nozzle with terrible force upon the buckets of a Pelton water wheel, which it drives at a high speed, and to

FIG. 1.—PERSPECTIVE VIEW OF PIER, SHOWING TWO FLOATS IN POSITION.

which is attached a dynamo or other machinery intended to be operated. From the Pelton wheel the water drops back into the reservoir from which it was originally pumped, and the same water is thus pumped over and over again without waste and requiring no new water supply. The pressure tank feature

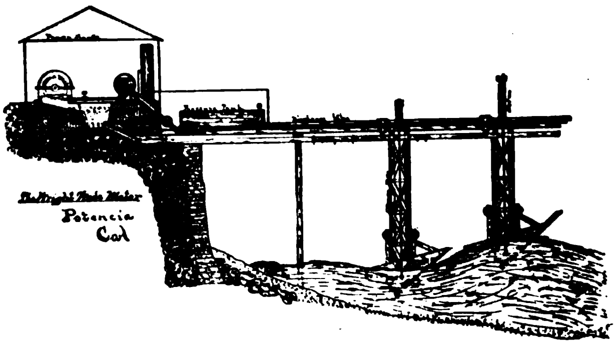


FIG. 2.—SIDE VIEW OF POWER HOUSE AND SECTION OF WAVE MOTOR WHARF, SHOWING TWO FLOATS.

of the invention serves to drive a water wheel by water with the same effect obtained by a water power under a high gravity head, but it reverses the old maxim that "the mill will never grind with the water that has passed," for that same water is again put under pressure and used as an endless chain to com-

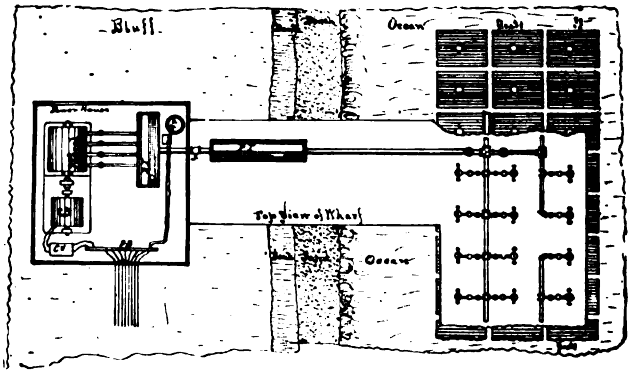


FIG. 3.—TOP VIEW OF POWER HOUSE, APPROACH WHARF, AND WAVE POWER PLANT.

pel continuous revolutions of the water wheel, and hence continuous, steady power for the generation of electricity.

But not only does the pressure tank serve to put the water pumped under heavy pressure proper to drive the water wheel, but it stores and equalizes the power from wave to wave, and

in addition furnishes an absolutely reliable automatic means of regulating the power created, so that during periods of excessive wave movement, as occur in storms, no more than a given amount of power can be created—for the spirit of the living creature seems to actuate this mechanism, so that during times of danger it practically furls its own sails as it were; this is done by the accumulated pressure in the pressure tank exerting itself upon the pump pistons, so as to offset the weight of the floats tending to draw such pistons down.

In the working wave motor plant the following is the method of construction and installation:

A wharf running at right angles to the beach has been constructed, running out to a point where the best average wave movement is obtainable; that is, to a point about where the swells usually begin to break, from which point a wharf with metallic piling is being constructed, running parallel to the beach and following along the line of the best average wave movement. Each of the piles will be of iron beams and will serve as a guide for the float; and attached to the wharf, side by side, and facing the ocean, and three or more deep, the motor floats will be installed. To this wharf will be attached merely the motor floats and the pumping mechanism; one hundred or more pumps and floats will be connected by supply and suction pipes with one pressure or storage tank, which with the water wheel will be located and installed upon the high bluff on the beach in the power house, where the entire electricity generating plant will be located. Thus the reciprocating action of a great number of floats, distributed over a large area of ocean frontage and pumping into one storage tank, will, of itself, largely equalize the power delivered to the pressure tank. Side and top views of the power house, wharf and wave motor plant are shown in Figs. 2 and 3 respectively.

On the 8th of February additional tests were made with two floats in operation, which developed 8.6 h. p. The plant is small at present, but has been running an electric generator continuously since last September. The plant will soon be enlarged to 200 h. p. and a transmission line will be built to Redondo, a distance of four miles, to which current will be furnished for light and power purposes. All this would appear to show that the apparatus has passed the experimental stage and is doing solid, commercial work.

ELECTRIC TRANSPORTATION

The All-Day Efficiency of Elevated Motor Cars.

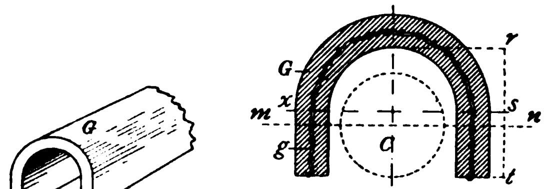
BY J. R. CRAVATH.

THE multiple unit system for elevated roads has had the point urged in its favor that its efficiency is higher than systems employing single motor cars or electric locomotives during light load hours when only two-car trains are to be run. Thus it has been claimed that since the electric locomotive or motor car used on an elevated road must be large enough to handle the longest trains that are ever run on the road, it must necessarily be working very much below its economical load when running a short train. At first thought this seems plausible. Superintendent W. E. Baker of the Metropolitan West Side elevated railroad of Chicago has recently called the writer's attention to the fact that under existing conditions of practice it is easily possible to make the efficiency as high on light trains as on heavy when single motor cars are employed. The time table of an elevated road is usually so arranged as to require the same schedule speed whether the trains be light or heavy. When the trains are heavy, the practice usually is to accelerate as fast as the heating of the motors will permit, and after getting up to speed keep the current on until it is time to apply the brakes. Now, if it is desired to keep the motors operating with the same efficiency with light as with heavy trains, it is only necessary to work them at the same rate during the time that current is turned on, allowing them to drift with current off during the balance of the time. Thus with a light train the controller can be worked so as to take the same current during acceleration as with the heavy train. The acceleration will then be quicker and a slightly higher rate of speed will be attained, but as soon as speed is attained current can be shut off and the train allowed to drift until it is time to apply the brakes. The theoretical efficiency of this latter method is higher than the former (see Mr. Steinmetz's discussion of M. H. Gerry's paper in October number Transactions, A. I. E. E.), so that the efficiency is, if anything, higher with the light than with the heavy train, due to the drifting that is possible in practice, if the right methods are employed. The single motor car system has also the advantage of having less weight to be moved than if motors are scattered through the train, so that the multiple unit system gains nothing on that score, except with two-car trains, where the weight is about equal for the two systems.

The single motor car system may be old, but it is not entirely bad after all. The only other point made against it for elevated work is that it does not allow sufficient traction for accelerating a long train, but it is noticeable that few companies can be found that care to pay for a higher acceleration rate than a single motor car affords.

The Sewall Conduit on the Chicago City Railway.

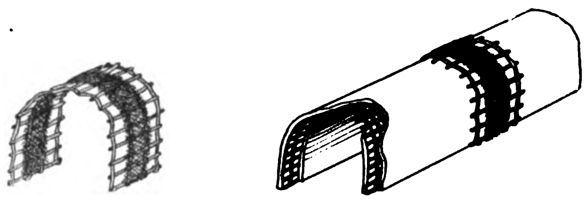
IT is notable that but few forms of conduits for carrying underground cables have ever been found a commercial success or won universal favor. An addition to the successful list seems nevertheless about to be made by C. H. Sewall, of Chicago. Mr. Sewall has been studying conduits for some time and now has a system that is entirely practical and has some decided advantages over others. A short stretch of this conduit was laid some time ago by the Chicago City Railway at Thirty-ninth street and Michigan avenue. Cables have been drawn through it now for a year, and it is giving satisfaction, although



FIGS. 1 AND 3.—DETAILS OF SEWALL CONDUIT SHOWING SHAPE OF DUCT AND IMBEDDED WIRE LATHING.

it was the first laid and many improvements in details have since been made.

The conduit consists essentially of ducts formed of cement arches, Fig. 1, embedded in concrete, as shown in Fig. 2. The cement arches are made to accommodate cables of any size specified (usually 3 inches) and the thickness of the arch walls is from 3-16 to ⅜ of an inch. They are made of a mixture of 50 per cent. Portland cement to 50 per cent. sand. Embedded in the cement of the arch is a wire lathing composed of iron wire .035 inch in diameter and with meshes ⅜-inch square, as shown in Figs. 3 and 4. This wire cloth performs a most important part in strengthening the arch. The arches are made by spreading the cement over a core. The lathing helps hold the cement



FIGS. 4 AND 5.—DETAILS OF SEWALL CONDUIT SHOWING IMBEDDED WIRE LATHING AND THE JOINT COVER.

together until it is hardened, which is in about seven days. The arches are made in 6-foot lengths for straight work. One great advantage of cement is that it does not warp in drying, and these arches, when completed and ready for use on the street, are as straight and true as the cores from which they were made. The arches being prepared the trench is dug and a concrete foundation of Portland cement, sand and broken stone is laid. On top of this foundation a smooth cement floor is spread and troweled to a polish. The arches, thoroughly wet, are laid on the floor under a template which gives them absolute positions. As the arches come from the molds exact in size and the work in the trench is done with accuracy, the floor being a perfect plane, the joining of the arches end to end is

easily made very accurate. As soon as work has fairly started on one tier of arches they are covered over at once and work is begun on a second tier; the process can be indefinitely continued as it is not necessary to wait for the cement to set. The joints between the arches are covered with wire lath and cloth to prevent concrete from falling through into the ducts during construction. The joint cover is shown in Fig. 5 and also in Fig. 2. The corners at the ends of the ducts are slightly beveled to prevent cutting the lead cable covering in case the ducts are not in perfectly accurate alignment. Where there are to be curves in the ducts, it is a simple matter to manufacture short curved pieces of duct of the proper radius, and these can be joined to turn any kind of a corner desired as shown in Fig. 6. The curves can be made long, short, reverse, or any kind needed, by joining these short curved sections.

The construction having been shown it remains to discuss its commercial advantages over other forms. The object of a conduit is of course to furnish a permanent duct or set of ducts which will allow the easy pulling in and out of lead-covered cable at all times, which will be strong enough to withstand all strains put upon it without interfering with the continuity of the duct and without offering rough or irregular duct surfaces to cut or bind the cable and collect sewage water. First, in the matter of alignment, it is evident that as the duct floor is jointless and perfectly plane, the cable rests on a surface which has absolutely nothing to abrade the lead or make it draw hard. Furthermore, the ends of the arches being made to exact size and laid to templet with corners slightly beveled there is but little chance for bad horizontal alignment. This means that longer lengths of cable can be drawn in than with other conduits. The same perfect smoothness of duct interior is maintained on curves.

By reference to the figures it can be seen that the arch form of duct is the one combining greatest strength with least resistance to pulling in the cable. The cable in the arched duct touches only three points, the floor and the two sides. In the round duct it practically rests over a considerable area on the bottom of the duct. A square duct is easy to draw through, but is deficient in strength as compared with the arch when the two are made for the same size cables. When we consider the amount of space taken up by the ducts there is no difference between the arch and the square or round ducts. As to durability of material in the Sewall conduit there is nothing exposed but hydraulic cement concrete, which is practically indestructible underground. The strength of this conduit structure is one of its good points. Concrete has greater compressive and tensile strength than terra cotta, and iron wire has the greatest tensile strength of any material. These two materials are combined in this structure and the result is that a much smaller cross section of material can be used for a given number of ducts.

In each arch there are twenty-two wires lengthwise with an aggregate tensile strength of 2,000 pounds, and thirty wires of the same size crossing them to every lineal foot of arch. In whatever direction the mass is strained, many wires will come into tension and resist. The fact that the arches and the concrete filling unite to make practically one mass adds to the conduit's strength over what it would be if ducts and filling were different material. The greatest element of strength in this conduit, however, is the fact that the floors are jointless and the duct joints are alternated so that at no one place is the conduit mass weaker than at others. The strength of any conduit is limited by its strength at its weakest points, viz.: the joints, and the Sewall construction makes it practical to distribute the joints and allow the surrounding mass to be made of less cross section than if the ducts were of another material. The floor being jointless there are no pockets to hold sewage as is sometimes the case with present conduits.

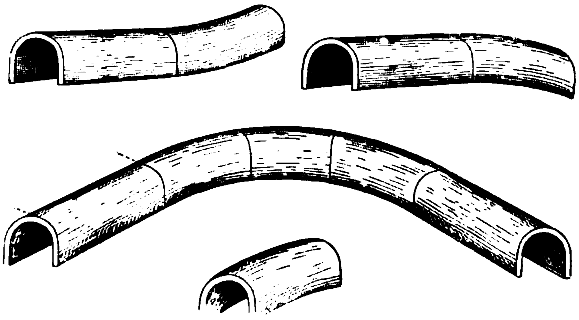


FIG. 6.—CURVED PIECES OF SEWALL CONDUIT DUCTS.

As no very expensive materials or processes enter into this construction of conduit, it can be laid at no greater cost than present forms.

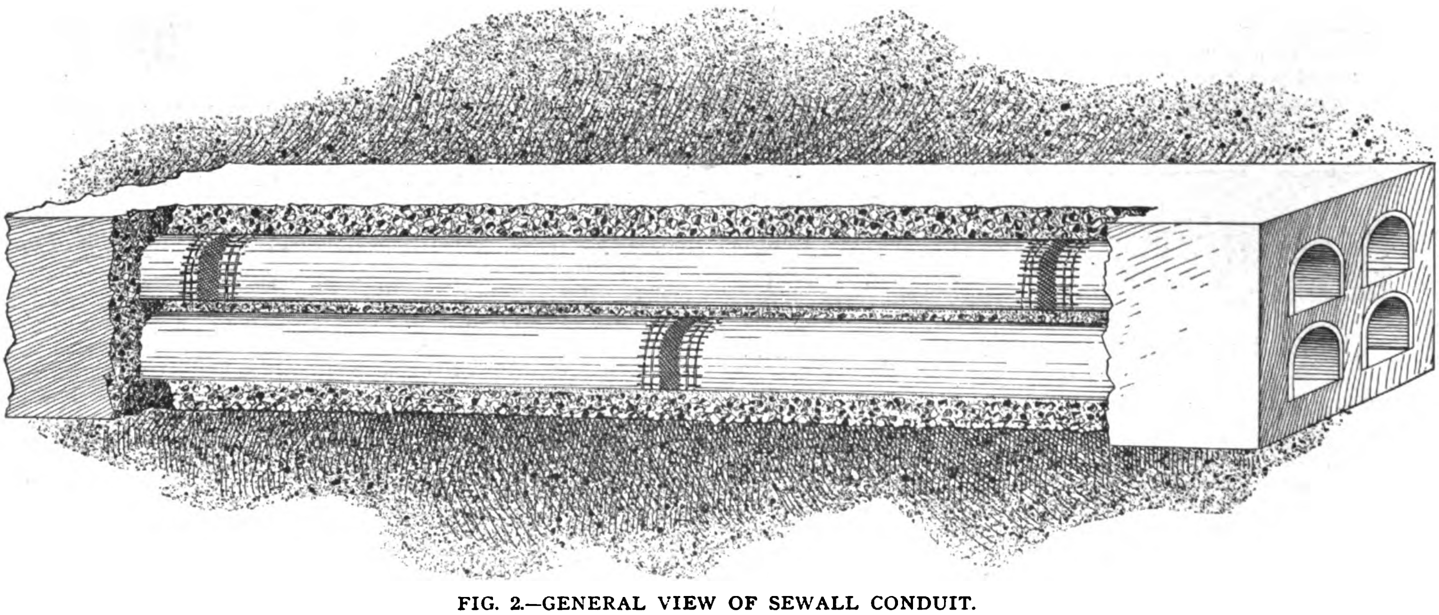


FIG. 2.—GENERAL VIEW OF SEWALL CONDUIT.

BRISTOL, CONN.—The Bristol and Plainville Tramway Company are erecting near Plainville, Conn., a new substantial steel bridge, having a span of about 90 feet. The bridge has been designed with a view of being a permanent structure, well able to take care of the increasing and heavy traffic of the road. It has been furnished and is now being erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

BUFFALO, N. Y.—The Buffalo, Hamburg and Aurora Railway Company has sent out its plans and specifications to a number of general contractors, and bids for 19½ miles of construction, 1,400 h. p. generating plant, and car barns have been opened. Mr. U. L. Upson is secretary and general manager, Ellicott Square Building.

Heavy Electric Traction.—The Mason City and Clear Lake Road.

ALMOST immediately upon the production of a system of motors for heavy traction the Walker Company began to install them on many railroads. Among the latest recruits to the interurban railroad equipment with the Walker system is the Mason City and Clear Lake railroad, owned and operated by the Mason City and Clear Lake Traction Company. They have been successfully transacting some very heavy traffic electrically. In Fig. 1 is illustrated a motor car equipped with four 50 h. p. motors, arranged in pairs on bogie trucks. This car is used as a locomotive and its regular duty is to propel, at a speed of 30 to 40 miles per hour, a train of six 40-foot trailers, which are often heavily loaded with passengers. Fig. 2 illustrates this train at its regular work and gives a good idea of the character of the cars composing it.

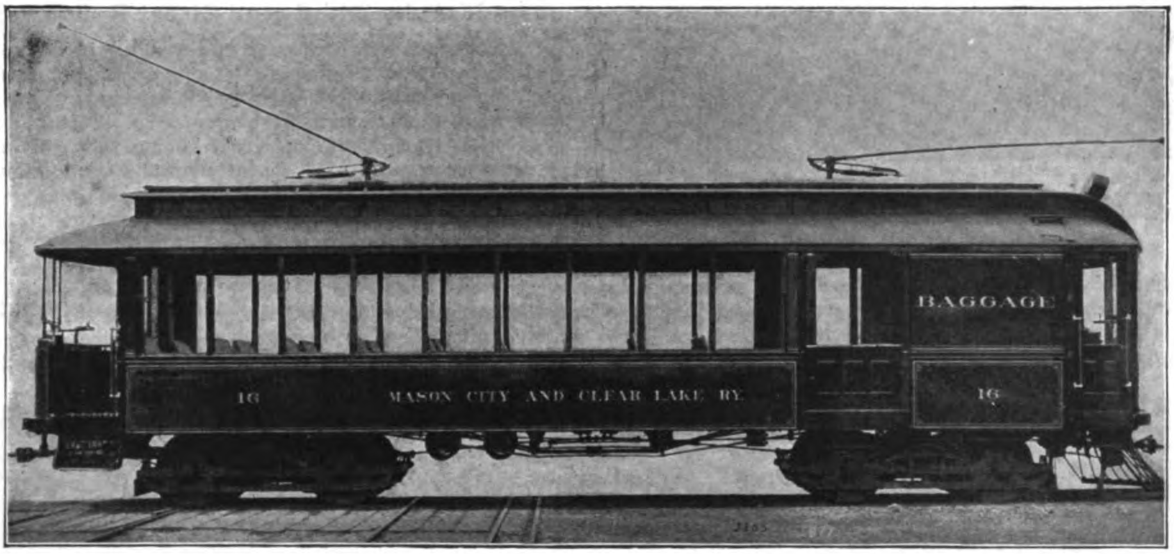


FIG. 1.—MASON CITY AND CLEAR LAKE MOTOR CAR EQUIPPED WITH FOUR 50 H. P. WALKER MOTORS.

This large car is frequently used for hauling short freight trains. It has handled eight heavily loaded cars without difficulty, and drawn them at a speed of 32 miles an hour, and the management of the railroad believes that it could handle ten and possibly more if occasion should arise. The heaviest grade on the road is 2 per cent.

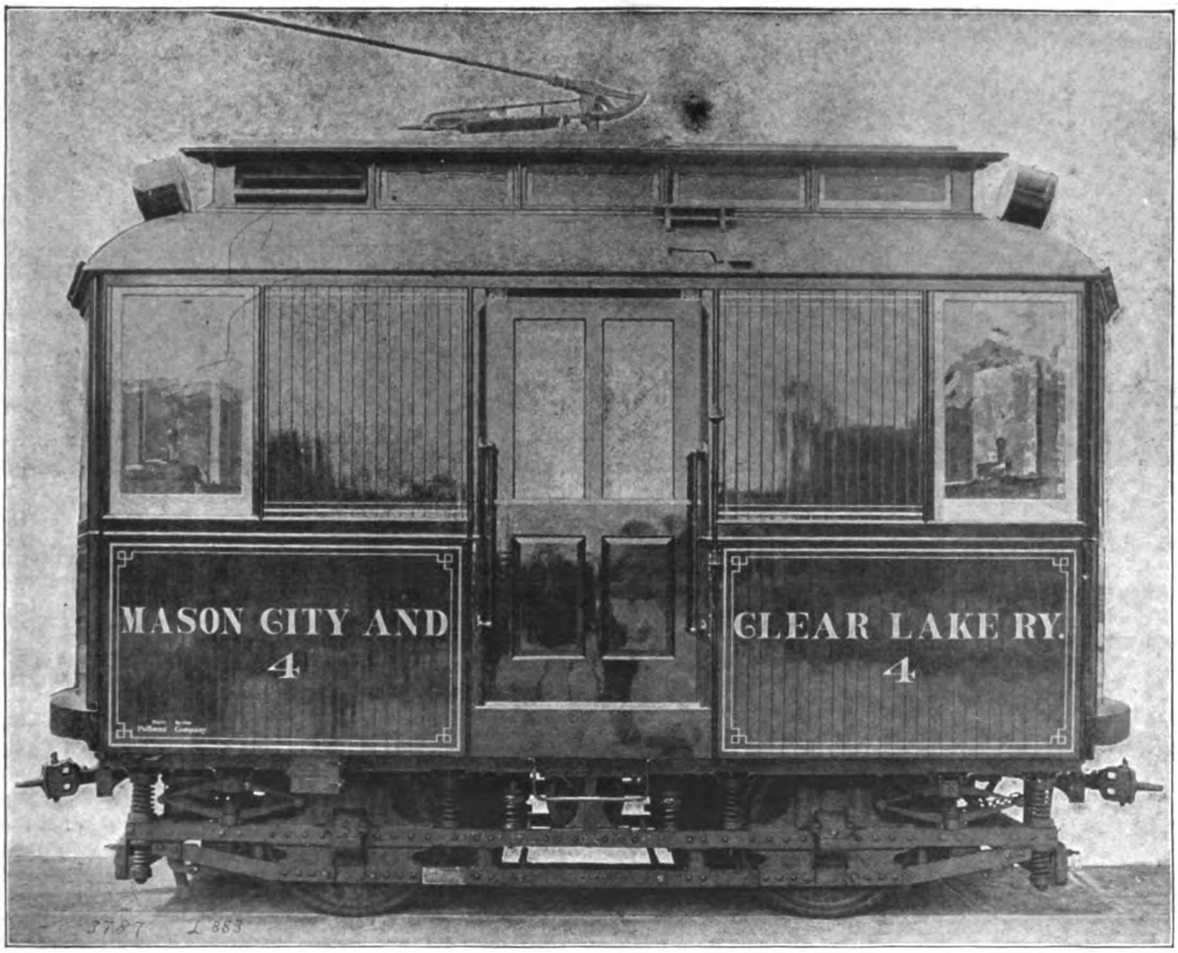


FIG. 3.—WALKER ELECTRIC LOCOMOTIVE, MASON CITY AND CLEAR LAKE RAILROAD.

In Fig. 3 is illustrated a Walker electric locomotive, in use

on the line. In external appearance it is not impressive as being a particularly powerful machine, but it carries on each of its car axles a 75 h. p. motor. Though its complete weight is but

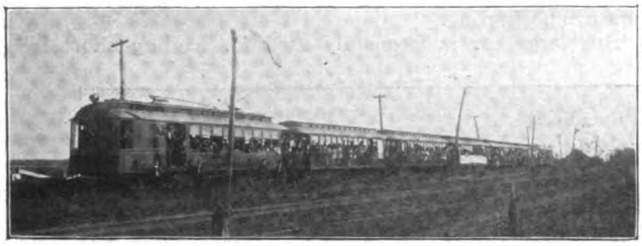


FIG. 2.—TRAIN EQUIPPED WITH WALKER MOTORS, SPEED 30 TO 40 MILES PER HOUR, MASON CITY AND CLEAR LAKE RAILROAD.

20,000 pounds, it can rapidly accelerate a train of six loaded freight cars, each of which is more than double the length of the locomotive that propels them. This locomotive, connected to a train such as it commonly hauls, is shown in Fig. 4. The Mason City and Clear Lake Traction Company have expressed themselves as very much pleased with the equipments, and it seems that they have put them to severe tests which justify the

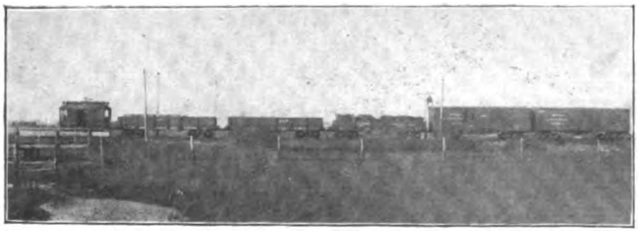


FIG. 4.—WALKER ELECTRIC LOCOMOTIVE CONNECTED TO A TRAIN OF CARS, MASON CITY AND CLEAR LAKE RAILROAD.

strong letters of recommendation which they have sent to the Walker Company.

The 50 h. p. motor is provided with the Walker patent suspension. There is absolutely no unnecessary dead weight on the axle and none of that weight can be considered as part of the motor. It consists merely of the gears and casing and axle bearings, the connections of which to the car axle are inevitably rigid. Both of these motors have been extremely popular in interurban work and are being largely sold.

The Murphy Third-Rail Street Railway System.

Ever since electric street railroading became established on a practical basis, some method of avoiding the stringing of overhead trolley wires has been sought for, and many have been the attempts to overcome it. Naturally, the first suggestion which presented itself having this end in view was to place the conductors in an underground conduit, and take the current from them by means of a plow, on lines quite similar to the old cable roads. The cost of such underground construction naturally deterred street railways from undertaking it, and even at the present day—more than twelve years after electric railroading has become an established branch of the art—New York City and Washington are the only places in the country where such underground roads have been put down. The old objection as to cost, therefore, still predominates, and

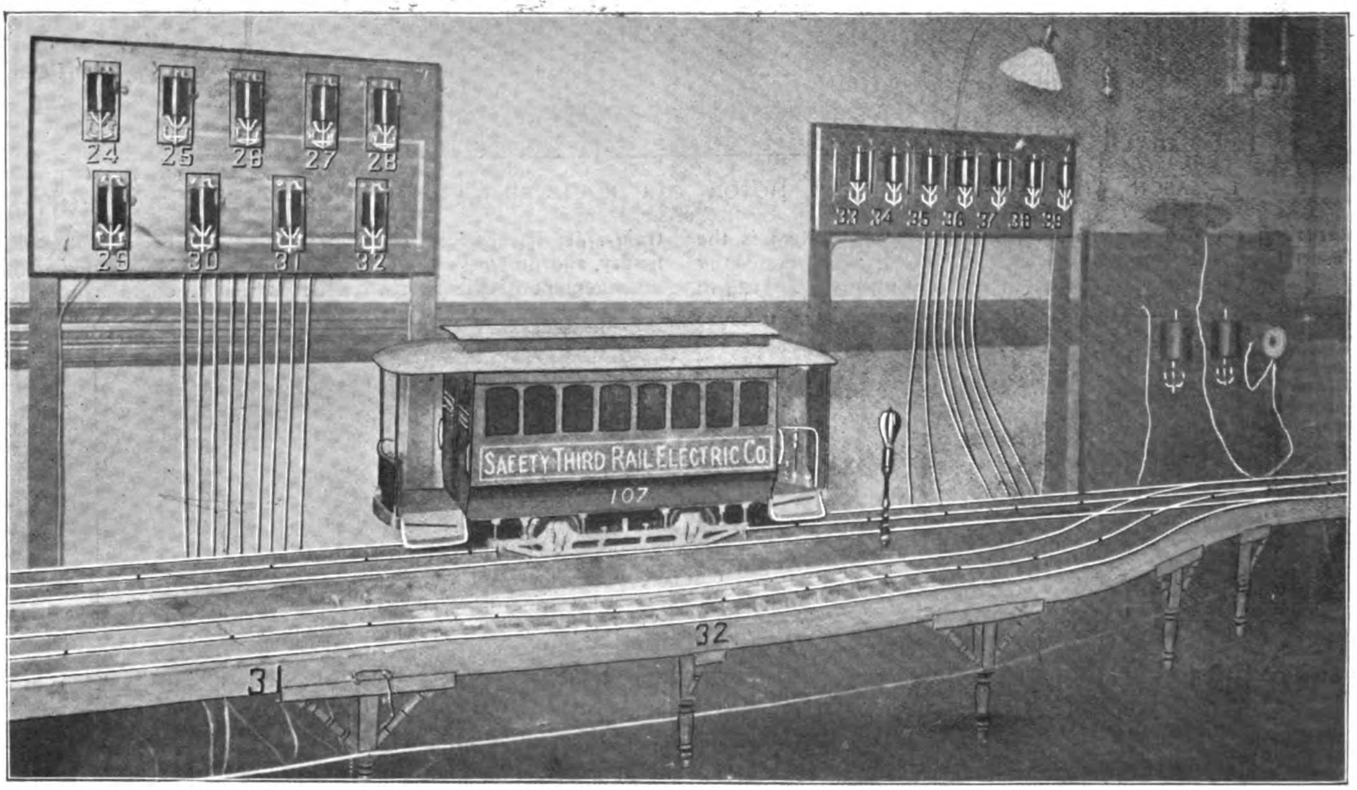


FIG. 1.—VIEW OF CAR ON MURPHY TRACK WITH VAULT SWITCHES.

will probably continue to do so for an indefinite period. To devise some means of avoiding the flimsiness and unsightliness of overhead construction and, on the other hand, the costliness of the underground construction, has been the aim of many an inventor, and it must be evident that if a golden mean between the two can be devised it must of necessity appeal strongly to street railway companies.

We propose in the following to describe the most recent attempt to solve this problem, due to the efforts of Capt. J. McL. Murphy, electrical engineer of the Safety Third-Rail Electric Company. To demonstrate the practicability of the Murphy system, the company has had constructed a miniature car and track, every detail of which is a perfect reduction to a scale 1-6 of the actual working size. This miniature railway system, installed in the Temple Court Building, New York, was last week shown in operation before a number of gentlemen prominently interested in railway matters, and we believe our readers will be interested in a description of the Murphy system, which embodies a number of novel features of operation.

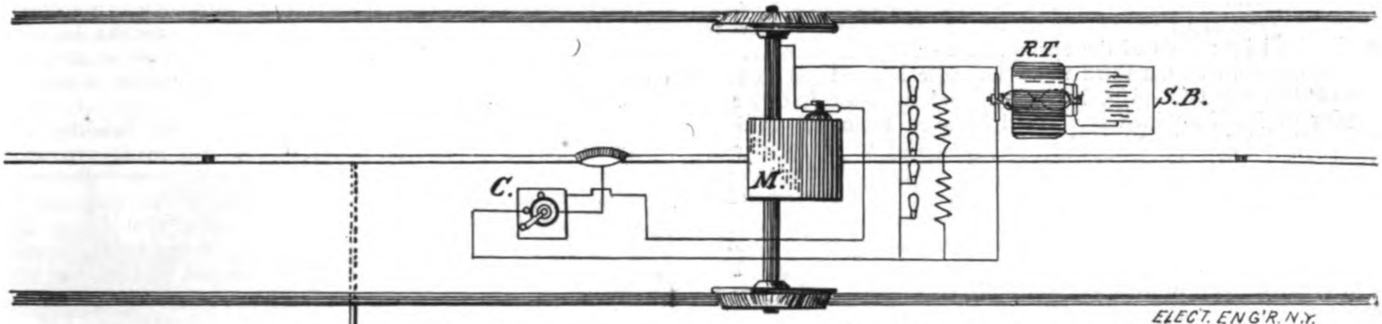
The accompanying illustration, Fig. 1, shows a part of the miniature track, which embraces all conditions met with in

actual practice, such as turnouts, track switches, signal lanterns, etc., and including a submerged section, so as to illustrate the operation of the car with the track submerged in water.

The system is based upon the employment of a central third rail divided into sections which carry the current to the motor, the outer rails being employed for the return current. The third rail, as stated, is divided into sections, the alternate sections being charged and the remainder dead. These two types of sections are separated by a short length of insulation consisting of a special composition. The feed wires are led in a duct between the tracks, in the double track system, and consist of lead-covered cable. These cables lead to switch vaults placed between the tracks and situated at intervals of a block. From the switches the rail feeders are led to sections of the track to be charged.

In order to understand more clearly the operation of the car the reader is referred to Fig. 2, which shows diagrammatically the equipment of the car together with one of the "vault switches." The car, it will be noted, is provided with a storage battery, S B, of ten cells, which furnish current for a rotary transformer, R T, which converts the 20 volts of the battery into 500 volts, the potential of the line current. As the car passes over the section to be charged, the local current generated on the car by the transformer energizes the vault switches, V S, shown in perspective in Fig. 1, one of which is connected to each live rail section. Passing over for the time being the operation of this vault switch, the closing of the latter sends the line potential of 500 volts into a charged section through the motor M on the car, and at the same time into the rotary transformer. The latter is thus reversed and becomes a feeder at the 20-volt end, the current generated being fed into the storage battery, and thus keeping it constantly charged.

The engraving, Fig. 2, together with Figs. 3 and 4, shows the operation of the vault switches, one switch being provided for each charged section of the third rail. As will be seen, the switch is provided with two windings, an inner and an outer. The outer winding is connected to the main line feeders, y', through the medium of the switch contacts or jaws, a. The inner winding is connected to the car storage battery and rotary transformer circuit, and raises the lower jaw of the switch, A, to the yielding contacts, D E. As soon as this contact is made, the heavier outer winding, s', connected to the feeder, y', is thrown into circuit, increases the power of the solenoid and still further pulls up the core and switch to a solid contact. The further motion of the core through the medium of an upper extension rod, P, automatically breaks the circuit of the inner winding at the switch, G, which winding then remains dead until the car leaves the section. When the car passes on to the next section, the solenoid becomes de-energized, the switch jaw, a, drop with the solenoid core and remakes the contact, G, closing the circuit of the inner winding, and thus leaving the vault switch ready to be acted upon at the passage of the next car.



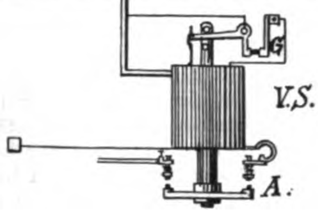
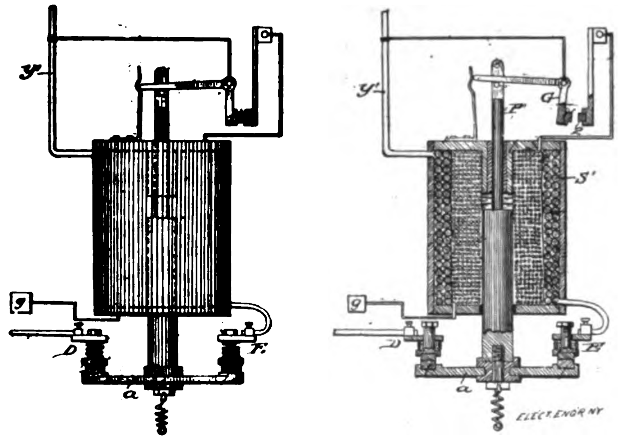
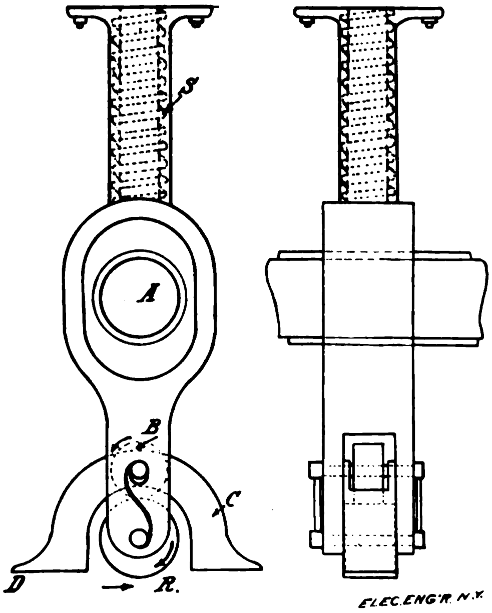


FIG. 2.—DIAGRAM OF CAR, TRACK AND VAULT SWITCH

A good idea of the operation of the switch can be obtained by referring to Fig. 2. In this illustration the vault switch, V S, is shown as it appears when there is no car over the section and the main switch contacts, A, are open, with the inner solenoid contact, G, however, closed. Fig. 3 shows the condition of the switch at the first instant of contact of the shoe with the third rail. The main switch jaw, a, has been drawn up into contact and admitted current to the car motor. At the next instant, however, the heavy current which has been allowed to pass draws up the main contacts, a, to their full length, opening the switch, G, and hence the circuit of the inner winding, as shown in Fig. 4.



FIGS. 3 AND 4.—SHOWING VAULT SWITCH, TWO POSITIONS.



FIGS. 5 AND 6.—TROLLEY SHOE, SIDE AND FRONT VIEWS.

The trolley shoe employed with the Murphy system presents a number of novel features. As shown in the illustration, Figs. 5 and 6, it is suspended from the bottom of the car body, and its middle section is enlarged so as to encircle the car axle, A. At its lower extremity it carries a roller, R, which runs in contact with the third rail. Resting on top of this roller is a second roller, B, to which is attached the actual contact shoe,

C. As the car travels along, the revolution of the lower wheel, R, turns the upper wheel, B, in the opposite direction and tips one end of the contact shoe, C, over until it comes in contact with the third rail, the contact of the shoe with the rail being always at the rear end. Thus if, as shown in Fig. 5, the car be traveling in the direction indicated by the arrow, the end D would be in contact with the third rail, the other end being tipped up clear of that rail. The two wheels, B and R, are maintained in contact by the spring shown and the double contact is maintained by means of the spring, S, which presses the roller and shoe down to the third rail. The axle is insulated so that no contact can take place between it and the shoe frame, and a play of ⅜ of an inch is allowed between them in addition. The axle of the wheel, B, also runs in a slot so as to give it free play. To provide for the smooth running of the motor, the bearing surrounding the car axle by which it is suspended has been provided with ball bearings, as shown in Fig. 7.

The live sections of the third rail are eight feet in length, while the dead or insulated sections are six feet long. The trolley shoes, two in number, being placed 6 feet 6 inches apart, must of necessity always straddle the dead or insulated sections, and thus operate the switch of the section ahead, so that it is charged ready for the approach of the car. As soon as the shoe leaves the section behind, that section immediately becomes dead, as was shown above, when describing the vault switch.

The controller of the car shown at C, Fig. 2, controls both

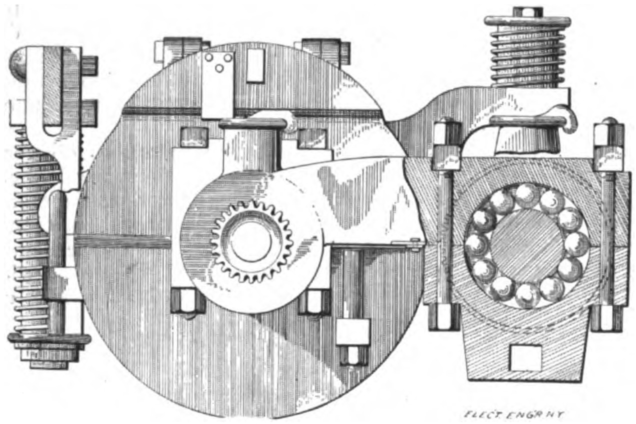


FIG. 7.—MOTOR WITH BALL-BEARING SUSPENSION.

the local car current and the main line current. Thus it will be seen that no rails can be charged or remain charged after the car has left the section. It will also be noted that under no circumstances can any person or animal receive a shock from the rail, for the reason that the full length of the car being twenty-two feet, the car body necessarily covers both charged sections, the two extreme points of which are covered by the car body, thus leaving no charged rail exposed, either ahead or behind. As a matter of fact, while the car is standing still there is no current in the track whatever, so that there is a double safeguard against anyone coming in personal contact with the charged conductors.

In addition to the operation of the car itself, the Murphy third rail system provides adequately for the automatic operation of the track switches and signals. The track switches, in fact, are operated by the controller on the front platform, which at the same time operates the visual signals indicating to the motorman that the switch is "O. K.," and signaling the motorman coming in the opposite direction. The system also acts as a danger signal at railroad crossings. In addition to this, and at the same time a switch is automatically operated in the vault connected to the track in advance, which cuts off all current from the car approaching in the opposite direction, thus avoiding collisions, while at the same time displaying a signal. This feature is especially adapted for single track roads. When the car, after clearing the switch, passes to a new section it automatically restores the vault switch to its original condition and leaves the line clear to be operated on by the next car.

As was stated above, when the car is at a standstill there is no current in the track, and hence under ordinary conditions no current would be furnished to the car for lighting or heating purposes when the car stops to take on or let off passengers. This condition has, however, been very ingeniously provided for by calling upon the storage battery for this work. As described above, when the car is running, the rotary transformer is constantly in operation charging the storage battery, and when the car stands still the storage battery provides all the current necessary for these two purposes, being constantly fully charged.

In cases where street car lines run out into suburban sections arrangements can be easily effected for automatically lighting up the road ahead for any desired distance, so as to give the motorman full view of the track and to warn people of the approach of the car.

In addition to the other precautions for the liability and safety of the system, Capt. Murphy has also made provision for the liability of the vault switches holding up or "sticking," by whatever means this may be produced. To provide against this contingency a fuse has been introduced so that if a switch should fail to open one, or two, seconds, or any longer period of time desired after the car leaves the charged section, the fuse will blow and cut that section out.

In the miniature railroad, shown in the engraving, Fig. 1, there is, as stated above, a section four feet long which is depressed and runs in a trough in which the rails are submerged half an inch below the surface of the water, which is two inches deep. In the experimental run of this miniature railway the water was fully saturated with salt and other material met with in street railway practice. The car was brought to a standstill over the submerged section and started from a dead rest. The leakage of current at 110 volts was only eight amperes. This, however, was insufficient to hold up the vault switch, and hence the car received no current, twelve amperes being the maximum required to operate the switch.

In the Murphy third rail system no departure has been made from the present standard practice for the equipment of electric street cars beyond one change in the controller and the installation on the car of the storage battery and transformer, which increases the weight only 600 pounds.

It will thus be seen from the description of the Murphy third rail system that it has been worked out with considerable care and that it has been especially designed to meet all conditions of actual working. If the operation in practice can be brought to the same perfection as that reached on the miniature system, the Murphy third rail system certainly has a very bright future before it.

Storage Battery Cars on the Grand Street Line, New York City.

SOME weeks ago the president of the Grand street crosstown line was authorized by the Board of Directors to employ an expert engineer to make an examination of the storage battery line now operating in Chicago. This examination was made, with the result that such a favorable report was presented that the directors further authorized the equipment of a small electrical plant at their car barn, and the operation of at least two storage battery cars, for a sufficient length of time to determine whether or not the conditions under which the cars would be required to operate in this city, would cause an increase in the cost of operation and maintenance over that obtained on the Chicago road.

Four cars were leased from the Chicago Electric Traction Co. (formerly the Englewood & Chicago Electric Street Railway Company), together with the batteries and other equipment necessary for the operation. An elevator and a 90 h. p. direct connected Westinghouse gas engine unit were installed at the Grand street car barns, and for over thirty days past, two of the cars have been in regular operation, making from 90 to 95 miles per day each. On account of the worn-out condition of the track, the operation of the cars has been carried on with considerable trouble. Weak joints and curves permitted the cars to jump the track, and caused a much greater expenditure of energy than would have been the case had the road been in good condition.

Another factor which would militate against economical operation is that the motors are designed for a normal speed of 16 miles per hour, whereas the speed at which they are now operating on Grand street is only six miles per hour. These motors are designed principally for long high-speed runs, such as occur in suburban operation, and therefore are at a disadvan-

tage when run at slow speed, combined with continual stopping.

Even under these unfavorable conditions, the power consumed has been very satisfactory, as the average energy recorded at the switchboard is 1.94 kilowatt hours per car mile, during the period from March 14th to 26th inclusive. It is only reasonable to assume that under favorable conditions of track and motor, the actual operation could be reduced to not over 80 per cent. of the above figure, or 1.55 kilowatt hours per car mile. This would give on the car an expenditure of considerably less than an electrical horse power hour per car mile.

Under the circumstances, all concerned feel very well satisfied with the operation of the cars. As the cars have demonstrated all that was necessary, they will shortly be withdrawn.

Municipal Electric Lighting.[1]—VII.

BY PROF. JOHN R. COMMONS.

MUNICIPAL DEPRECIATION FUNDS UNNECESSARY.

WE can now make plain another reason why a city need not accumulate a depreciation fund and why a private company must do so. In a city the entire taxable property of the citizens is liable to assessment when the time arrives for purchasing new machinery in place of old, while in a private company only the capital actually invested is so liable. In the former case, therefore, the increased tax rate for replacements would be so insignificant as to need almost no consideration; in the latter it would wipe out the dividends and reduce the capital stock to a mere speculative interest. For example, the assessed valuation of taxable property in Detroit is $209,586,330. The tax rate for all purposes is fifteen and seven-tenths mills on the dollar. The entire lighting plant cost $729,222. The electrical part of the plant cost $63,701. Supposing this part were to be entirely replaced in a single year, the tax necessary for the purpose would be only three-tenths of one mill, which would increase the tax rate from fifteen and seven-tenths mills to sixteen mills. If the same assessment were levied on a private company which had invested $730,000 in the enterprise the rate would be eight and seven-tenths per cent. (eighty-seven mills on the dollar). But the entire electric plant would not need reconstruction in a single year. Its replacement, together with that of the entire depreciable part of the plant, could be distributed over say twenty years. This depreciable part of the Detroit plant is $431,186, making $21,559 to be replaced each year. On the entire taxable property of the city this would be a rate of only twenty-six one-hundredths of a mill, bringing the total rate to 15.96 mills. On the private capital invested this would be a tax of three per cent. or thirty mills on the dollar. But this is not all. The private plant would, of course, be bonded for one-half its value, and the interest on the bonded debt at six per cent. would be a prior lien on the earnings. Consequently, the cost of replacement would come out of the stockholders representing but one-half the investment. The assessment on stock for replacing one-twentieth of the depreciable plant would, therefore, be six per cent. as against the twenty-six one-thousandths of one per cent. which the taxpayers would be assessed. The capital stock in the one case would be wiped out, but in the other the taxpayers would be unaffected. Even this comparison is unfair to the city of Detroit, for it must be remembered that in 1893 and 1894 the tax on property for lighting by a private company was $175,000 yearly for 1,279 lamps, while now it is only $144,000 yearly for all operating expenses and interest on 1,700 arc equivalents. This leaves a balance of at least $30,000 yearly, minus sinking fund and new construction without considering the increased lighting, on which to draw for replacements when needed, before the expense can be said to approach that of private lighting. Under such circumstances I do not see how the municipal authorities can be charged with "bad bookkeeping." Judged by private standards they could be so charged, and those thousands of private companies which are now distributing what ought to be their reserve funds in dividends to stockholders are either presuming upon their power to force the public to pay for replacements when they come, or their shrewdness in bolstering their stock and entrapping future innocent stockholders who in turn must reckon with the municipalities.

Below is a table showing the facts just stated concerning Detroit, together with comparative tables for smaller places. It will be seen that small places with heavier investments relative to taxable property than Detroit must incur a heavier tax rate for replacements. This rate is five-tenths of one mill in Braintree and seven-tenths of one mill in Reading, Mass., two and three times the estimated rate in Detroit. But the Braintree and Reading plants are both commercial and street plants, and this brings in a new consideration, namely, the relations between taxpayers and consumers in the maintenance of the electrical works.

TABLE IX.

COMPARATIVE BURDEN OF REPLACEMENTS ON MUNICIPAL AND PRIVATE CORPORATIONS.

	Detroit. Street Plant. 1897.	Braintree. Street and Commercial. 1894.	Reading. Street and Commercial. 1896.	Braintree. Street Plant. 1894.
Total valuation of taxable property	209,586,330.00	$4,424,225.00	$3,206,466.00	$4,424,225.00
Tax rate on $1.00	.0157	.0172	.0155	.0172
Total investment	729,222.00	54,600.00	67,098.00	30,160.00
Total cost electric plant	63,701.00	7,640.00	7,026.00	2,740.00
Tax rate on $1.00 necessary to replace electric plant entire	.0003	.00172	.0022	.0006
Assessment on capital invested necessary to replace electric plant	.087	.14	.103	.091
Total cost of depreciable plant—machinery, posts, lamps, lines	431,186.00	45,820.00	43,991.00	21,380.00
Tax rate on $1.00 necessary to replace 1-20th of depreciable plant	.00026	.00050	.0007	.00024
Same added to existing rate	.01596	.01770	.0162	.01804
Assessment on capital of private company (stock and bonds) invested, necessary to replace 1-20th of depreciable plant	.03	.042	.032	.035
Assessment on capital stock alone (estimated at ½ total capitalization	.06	.084	.064	.07

COST UNDER PUBLIC AND PRIVATE OWNERSHIP.

Heretofore I have considered only those cities in which the municipal plant is limited to street lighting. In such cities the taxpayers alone are concerned as to the charges for depreciation. But the inevitable tendency of municipal ownership is to enter the commercial field. Every one of the municipalities owning plants in Massachusetts has already added or voted to add this branch to its municipal plant. The advantages to the citizens in taking this step are so patent and unquestionable that when a municipal plant has once been installed they become restless under private commercial lighting. The city of Jamestown, N. Y., added its commercial plant after the street plant had been operating a couple of years, and one large consumer who had been paying $1,400 a year for lighting now gets his light from the city for $900. A prominent social club had been paying $450 yearly for lighting its rooms. In order to retain its custom the private company has reduced the charge for the same light to $120 a year. Lansing, Michigan, bought out the private plant and reduced rates at once from twenty cents per kilowatt to eighteen cents and again to twelve cents in two years.

[1]Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec. Engr.

MR. E. M. TAYLOR, of the Newark, N. J., Telephone Company, recently carried out some interesting work in telephone transmission between Newark, Jersey City, Harrison, Bound Brook, Union Hill, Plainfield and other places. The phonograph was used for both the reception and transmission of the songs, together with large megaphones, placed in the hall at Newark. The entertainment was under the auspices of the Seth Boyden Council, O. U. A. M.

STERLING ARC LAMP COMPANY, of the Borough of Manhattan has been formed with a capital stock of $100,000. The directors are Andrew Faulds, Jr., J. G. Galland, Paul Raff and Michael Wallstein.

THE

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The Growth of Telephony.

FEW things in the electrical field are more striking than the growth of telephony. The art which has grown up around the inventions of Bell, Gray, Edison, Hughes, Scribner, and others, may not be so obtrusive in its outward manifestations as electric lighting or the trolley; but its effects on the social economy are certainly as widespread and beneficial. The will of the Lord is heard in its still, small voice as clearly as in the roar of the big dynamos and the rumble of the electric cars, and it serves quite as efficiently as they, though less ostentatiously to maintain and increase that intercourse upon which civilization most vitally depends. Twenty years ago the telephone was unknown to mankind at large; to-day there are said to be just about 1,500,000 telephone subscribers in the world, of whom by far the larger half are in the United States. Recent figures, whose full authenticity we do not undertake to guarantee, say that the grand total is made up about as follows: The United States leads the list with 900,000 (?), then comes Germany with 140,000, and Great Britain with 75,000; Switzerland, 50,000; France, 35,000; Austria, 20,000; Russia, 18,000; Sweden and Norway, 16,000; Bavaria, 15,000; Denmark, 15,000; Italy, 14,000; Holland, 12,000; Spain, 12,000; Belgium, 11,000; Hungary, 10,000; Würtemburg, 7,000; Finland, 6,000; Japan, 3,500; Cuba, 2,500; Luxembourg, 2,000; Portugal, 2,000; Australia, 2,000. The remainder is divided among the smaller countries, from Roumania with 400, down to Senegambia with 100. Our own estimate is that there are not more than say, 600,000 telephone subscribers in this country. The Bell system has about 400,000.

The annual report of the American Bell Telephone Co., digested elsewhere in this issue, bears eloquent testimony to the growing use of the telephone. It is, moreover, to be borne in mind that this report no longer represents the full use in this country, for the reason that there are now hundreds of independent exchanges, some very large, and many of them very busy. Still, the Bell figures are impressive enough, with 919,121 instruments under rental; 1,962 exchanges and branch offices; and a total revenue by all the allied companies of $4,435,515. Most remarkable of all is the use made of the system, showing a total of 998,000,000 telephone connections per year, or 3,099,472 per day, or 8 1-10 per subscriber daily, at a cost of from 1 to 9 cents each connection, according to the service rendered. As each telephone talk is never less than a few hundred words, and as a telegram costs at least 15 cents, it will be seen that as a means of intercommunication the telephone has seriously distanced the telegraph. Taking into account the work of the independent exchanges, the guess may be hazarded that the total telephone calls in this country are now from 1,200,000,000 to 1,500,000,000 per year. It is open to question whether the number of telegrams sent by the public has yet reached 100,000,000 per year. Once more the doubt must be expressed, whether the telegraph is used in anything like the measure of its possible utility and cheapness.

Moreover, while the telephone for long distance work does not compare with the telegraph in cheapness, it is rapidly widening its range, in spite of the necessarily high price for the service, its instantaneity being the great recommendation. We understand that just recently in these anxious times, the use between New York and Washington for all manner of service, has been tremendous; while long lines of railroad are employing it more and more. We illustrate this week an excellent example of railway telephony. There will be more illustrations of this kind as the years go by. Looking at the whole situation squarely, we must confess our belief that the telephone art to-day in America is advancing very rapidly, as the result of the independent movement, which has justified itself not alone by its swift extension but by the stimulus applied by it to the old companies. There are Bell exchanges to-day, however, that have ever been progressive, and that by their lavish expenditure and employment of the highest talent have placed telephony in this country far above any sort of comparison with that in Europe. That they will continue to hold their own by steady improvement and by a continuance of judicious innovations in service, as well as by scientific methods of metering that service according to the price paid, is a probability few will dispute.

The Accuracy of Electric Meters.

OF all the commercial apparatus, upon which popular abuse and denunciation have been heaped, none has needed less defence or had to stand severer attacks than the meters for registering the consumption of current. The mistrust of the general public as to the honesty of large corporations and the belief that they are paying for more than they have actually received may be ascribed to a natural human instinct, or, perhaps, a force of habit contracted while dealing with companies distributing gas, water or steam. Be this as it may, the condemnation of the electric meter, justifiable as it may have been in the past, has had its birth in nearly every large city in the United States, and according to latest reports has at last reached San Francisco, way off on the Pacific coast. We hope that this popular misconception or prejudice will continue its course in a westerly direction, until it is in the deep bosom of the ocean buried.

While it is, of course, impossible to guarantee the absolute accuracy of any commercial piece of apparatus, or to insure its correctness after it has been removed from the care and supervision of the officials of a company, it may be stated at the outset that no company can win permanent success by indulging in dishonest practices. To perfect their machinery, substitute the new and improved for the old and obsolete, to give better service and not overcharge customers is the underlying basis of all successful business management. We can cite no better illustration of this than the results achieved in the experience of the Edison Electric Illuminating Company, of New York. In its annual report for the year 1897 the following significant reference is made to the question of meters: "The Meter Bureau, under the general charge of the Controller, has continued its excellent efficiency during the year; it had under its care on December 31, 1897, 9,941 meters, of which 6,744 were Edison chemical meters and 3,197 mechanical meters. The usual careful attention has been given to complaints from customers, as to amount of bills, etc., of which 1,530 were received during the year. In connection with these complaints there were found 215 errors, of which 138 were clerical and 77 technical. The proportion of errors to bills rendered was 1 in 511, or less than one-fifth of 1 per cent., an increase of proportion above that of 1896, due in large measure to the extensive change from chemical to mechanical meters, involving a considerable strain on the Meter Bureau. There is reason to hope that the proportion will be considerably reduced in another year. The company continues its policy of offering to submit any disputed case to arbiters, and in general has succeeded in showing to customers its desire to treat every one with entire fairness."

In calibrating the mechanical meter care is taken that it does not run more than 2 per cent. fast or 5 per cent. slow, the meters all running a trifle slow on light loads. Applying figures to this apparently startling revelation, one finds that the customer will be but little affected even if the meter is out the maximum amount. For light loads the error might amount to a few cents each month, and for heavy consumers the companies have arranged such special rates and discounts as to cover any possible slight error in the meter, which, as stated, never exceeds 2 per cent. Again, should the company find that the meter was out more than 2 per cent. a reduction of the amount in excess of this percentage is made on the customer's bill. Meters are inspected at regular intervals or are checked at the consumer's request. And now we ask the consumer, whether there is any commodity, any piece of apparatus which he purchases, which is subject to closer checks and more accurate determinations than is his electric meter. We believe not, and are certain that the mechanical meter, if not tampered with, has no inherent faults and has fulfilled the following conditions essential to a successful meter: 1, accuracy; 2, range; 3, economy of energy; 4, simplicity; 5, durability; 6, minimum attention; 7, ease of reading; 8, ease of verification; 9, precautions against tampering; 10, cheapness; 11, not liable to freeze; 12, works equally well with direct and alternating currents; 13, independent of frequency; 14, good contacts; 15, portability.

The mechanical meter with plainly visible dials and in a glass case will undoubtedly remove the existing prejudice, for faith in any form of meter cannot be established, unless the people see the wheels go round.

Dr. Slaby On Wireless Telegraphy.

IN view of the general deep interest in electrical circles, touching the subject of wireless telegraphy, we venture to direct the attention of our readers to the discussion of the subject by Dr. A. Slaby, of Charlottenburg, Germany. In an article in the Century Magazine, entitled "The New Telegraphy," Dr. Slaby gives a splendid résumé of the work done by the early experimenters, such as Hertz and Tesla. He credits the former with establishing experimentally the identity of electricity and light, in quantity even if not in quality, and the latter with having made the first practical deductions, by directly transforming the electrical rays into rays of light. He calls the resonator of Hertz a weak and shortsighted electrical eye which was first made in the form of tubes, such as Branly suggested, by Lodge, whom he terms the father of the idea of telegraphing with electric rays and such tubes and who was the originator of the word "coherer." But, continues Dr. Slaby, the electrical eye which Marconi uses is essentially more sensitive; we may call it a clever improvement on the resonator of Hertz. He discusses in detail the coherer of Lodge and the receiver and transmitter of Marconi, establishing once for all the latter's indisputable claim of having worked out a practical arrangement for the apparatus which by the use of the simplest means produces a sure technical result. Marconi made telegraphy by sparks possible by using, on the one hand, earth connection between the apparatus, and on the other, the use of long extended upright wires. By this simple but extraordinarily effective method he raised the power of radiation in the electric forces a hundredfold. Dr. Slaby then describes the early experiments made in the Bristol Channel under the able supervision of Mr. Preece, the engineer-in-chief of the British Telegraphs, and his own later experiments at Potsdam, which were made possible by the liberality of the German Emperor. At a distance of eighteen kilometers, signals could be easily deciphered. Dr. Slaby concludes his very interesting articles by holding that we are really in the opening chapters of a grand development and none can say how far, and whither the path will lead us. He mentions the importance of the discovery in the military field, and for lighthouses and lightships, since the system works as surely on a bright day as by night and in fog. The chief condition for the success of spark telegraphy is that all obstacles which are found in front of the transmitter wire must be cleared away. An undeniable weakness of spark telegraphy, however, is this: every telegram is imparted to the whole world, every receiver can take it up. For practical purposes, if one desires to protect one's self from having despatches read by others, there remains always the use of a code arranged beforehand. In war, to be sure, telegraphy would become impossible as soon as a hostile spark generator should cause a permanent disturbance of the characters. A very interesting battle might occur in the waves of the ether. Notwithstanding these undeniable shortcomings, there is reason to rejoice at the discovery of the new telegraphy, and we cannot allow this reference to the subject to pass without noting also the very efficient work done in this country by Mr. W. J. Clarke. After months of patient experimenting, this inventor has designed and made available for use excellent apparatus suitable for the requirements of wireless or spark telegraphy in America, as shown in his lecture last week before the New York Electrical Society.

Electricity In Warfare.

WE are sorry to note that at this writing it begins to look like inevitable war with Spain, first of all to purge the national conscience of further complicity in the atrocities in Cuba; and, secondly, to avenge the "Maine," for no one can read the official report through without recognizing the culpable carelessness, or worse, of the foreign authorities to whom, as friends, the safety of the ship in their harbor was committed. Be the causes and reasons for war what they may, there is plenty of evidence that electricity as never before will play its part. We publish several items this week as to the electrical preparations going on, and each day brings some new tidings of electrical preparations, ashore and afloat. If the actual test of grim war comes, there will be deep interest in observing how valuable some of these preparations are. Some of them, such as the linking together by telegraph and telephone of coast defenses, and equipping even land forces with searchlights, are obvious and primary. But as Lieut. Fiske showed elaborately in our pages about a year ago, there are many novel applications, and it is these that most army and navy experts are concerned about.

We are heartily glad to note the steps taken to enroll volunteer electrical aid, and to know that such men as Capt. Eugene Griffin, Mr. Frank J. Sprague, Mr. H. Le Roy Emmet, and others, have been giving it their best thought and earnest effort. Whether war comes or not, one result of these stirring times must be the organization as a permanency of a strong reserve or volunteer electrical corps for duty along all our coast line.

Trolley and 'Rickshaw.

A TERRIBLE fellow that trolley, from the way in which he cuts into the established methods of travel wherever he goes. And like all his predecessors, he is cause of lamentation. If one delves into literature of the period when coaches first came in, there are storms of protest against giving up horseback transportation and sitting boxed up in a vehicle. Then as the steam locomotive came to the front, the stage coach became the theme of conservative lament, and around it was weaved all the charm of legend and romance. Now the steam locomotive is getting into the stage of pathos and swan song, while from the far East there reaches us a faint poetic appeal against modernity, as represented by the trolley. Our old friend, Mr. Thomas Ahearn, of Ottawa, Canada, now on his third or fourth voyage around the world with his family, sends us from Kandy, Ceylon, a weird outburst of grief, in verse, over the passing of the 'rickshaw. The sentiment is summed up in this terse stanza: "What more pleasant than the motion, Of a 'rickshaw speeding far? What more hateful than the motion, Of a Western tramway car?" But the 'rickshaw, and its coolie, and the khaki suit and belt of red must go. The unshod feet of the turbaned biped steed must go, before the invasion of the clanging, whizzing trolley. The loss is all on the side of the picturesque in the daytime, but at night the brilliant, flashing car will redress the scale; while fifty years hence our descendants will, like the Cingalese poet, drop into verse over the departing glories of the last trolley, and all its long era of marvel and mystery.

MISCELLANEOUS

Considerations Governing the Design of the Crocker-Wheeler Slow Speed Motors.—II.

BY GANO S. DUNN, CHIEF ENGINEER.

THE armatures of these motors have been difficult to design, since the low speeds require an extremely great number of convolutions, and the requirements of high efficiency compel the use of a wire of comparatively large area. This makes the proportion of copper to iron in the armature so great that it is difficult to find room for it, especially where the core is kept as small as possible to favor high efficiency at partial loads. An armature core, partially wound, is shown in Fig. 5. Were it not for the peculiar shape of the teeth employed, the wide slots between them would render the machine so inefficient as to be of little value. The overhanging lip distributes the dense magnetic flux coming up through the narrow tooth, so that by the time it reaches the polar surfaces of the field magnets the density is nearly uniform and eddy currents are avoided. The lip of the tooth serves also as a lock to hold the winding in place against the action of centrifugal force.

For the smallest size the wire is wound in place in trapezoidal slots. The core is made in halves to permit this to be done in a winding lathe and the parts are subsequently joined and mounted on the armature spider. For all the other sizes the winding is done on forms, previous to application to the armature. Each coil is wound, then properly shaped so it will nest with its neighbors, and then carefully insulated with layers of oiled muslin and tape applied by hand. When the winding has been put on the core, it is held down by the clamps at each end, and the connections of the coils are made to the commutator. The commutator bars have tails sufficiently long to keep cool and hold the solder, even if the commutator should through accident, become overheated.

The winding may be connected for multiple circuits or for two circuits, depending on speed, voltage and other conditions. Two-circuit windings are principally used because of the larger wire and fewer turns, making them simpler and cheaper, and because in these windings each pole has only a fractional influence on the total counter e. m. f., and therefore an eccentricity of the shaft with reference to the field bore or of the armature on the shaft or an inequality of some of the field windings, will not disturb seriously the electrical balance of the armature circuits. The two-circuit windings are always used for the low speeds, for several of the above reasons, and because at such speeds where the output is small, they permit the operation of the motor with as few as two sets of brushes if desired.

The windings of these motors, of which each individual coil is completely wrapped with insulation, are impervious to moisture and to dust, which permits them to be run in places where the air is filled with fine particles, without fear of damage and without the anxiety felt for an exposed winding, some parts of which are impossible to reach when cleaning. The manner in which they are applied to the core permits such ample ventilation that severe overloads can be withstood without destruction of the insulation, although they raise its temperature, of course, above the normal point.

The mechanical clearance between armature and field is for several reasons made large. It insures sparklessness, and, under the conditions of regulation, to be described later, is specially desirable. It insures, also, proper operation, even if, through wear of bearings or from failure to properly install, the armature is not exactly concentric with the field-bore. With an air gap of 1-16 inch, for example, a variation of 1-32 inch, from wear of bearings or other causes, would make a 50 per cent. change in the reluctance, and completely upset the magnetic balance of a multiple-circuit machine, but with an air gap of ¼ inch, a 1-32 inch variation would make only 12½ per cent. change in this reluctance, an amount within the power of the machine to withstand. Furthermore, in the first case, the unbalanced mechanical force tending to pull the armature sidewise, would be so excessive as to heat the bearings and cause serious loss of efficiency, if not a breakdown, while with the latter case the unbalanced force would be much smaller because of the small variation. A large air gap, too, permits the armature to get rid of its heat much more readily, and prevents the transference of heat to the field coils.

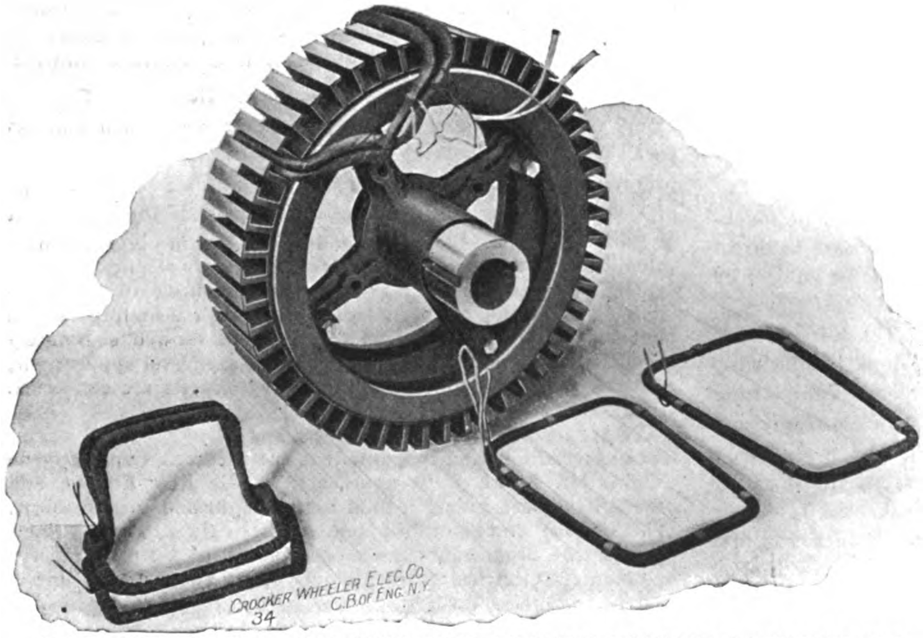


FIG. 5.—SIZE 1-100 C. W. ARMATURE CORE, SHOWING METHOD OF WINDING AND APPLYING FORMED COILS.

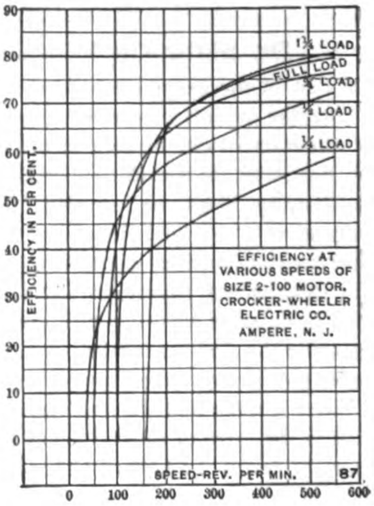


FIG. 6.—EFFIENCY AT VARIOUS SPEEDS OF SIZE 2-100 C. W. MOTOR.

The power of these machines is designated by the horse power each gives per 100 revolutions, and the sizes are therefore designated as follows: ½-100, that is, ½ h. p. per 100 r. p. m.; 1-100, 2-100, 3-100 and 5-100.

Fig. 6 shows the efficiency of windings of a 2-100 machine, covering a range of speeds from zero to 500 r. p. m., when loaded at ¼, ½, ¾, full, and 1¼ capacity. Where a curve indicates zero efficiency for a given speed, it means that the winding which would give that speed with the armature not loaded would have resistance enough to stall the armature if the load of the particular curve were demanded. Thus, from the curve, an armature which would run at 70 r. p. m. free would be stalled if called upon for three-quarters of its rated torque.

The upper limit of speed, on the other hand, is affected by no condition of armature resistance, but only by the centrifugal strains to which it is safe to subject the revolving parts, and by the capacity of the commutators to carry the large outputs the high speeds involve.

While special cases can be accommodated by alterations in de-

sign, the upper limit of speed for these machines is 500 r. p. m. for sizes ½-100 and 1-100, 400 r. p. m. for sizes 2-100 and 3-100, and 350 r. p. m. for size 5-100. It is possible to develop the same torque at all speeds without overheating because of proportions which make the temperature rise little dependent upon speed or actual h. p. output. For instance, if the armature is wound for a low speed, at which its ventilation is less, the hysteresis is also lowered, and this reduction serves as a compensation.

LETTERS TO THE EDITOR

The Proposed Electrical Corps.

I have seen a great deal lately about the proposed organization of a corps of electrical engineers for use in case of war, and similar to a corps said to have been formed in England some time ago. Now, how could such a corps be trained and for what particular purpose? Would those desiring to remain on land be given a special two weeks' course at Willett's Point and those taking up the navy have the same at Newport, or would they just trust to luck and a good brain training, and enter as privates same as any lineman or dynamo tender, and take the "haw bucking" of officers having a mere smattering of electrical training as compared with this corps? To make any valuable use whatever of the very considerable technical knowledge of such a corps, it seems to me it would have to be trained on the lines of the army and navy needs, and that much of the work would be special and almost personal. Please elucidate or develop some plan.

A. H. A.

Buffalo, N. Y., March 28, 1898.

Mr. Reid's Criticism and Its Critic.

I NOTE a letter in your issue of March 24 taking exception to various statements in my review of Wiener's "Dynamo Electric Machines." While I do not consider it a part of a reviewer's duty to uphold his opinions against anyone who may assail them, since everyone is at liberty to examine the book and form his own opinion, yet in this case, at your request, I will answer the objections advanced as fully as I can in the limited time at my disposal. My statements in regard to the misleading character of the title of the book, and to the effect of commutation on the armature flux, although they are mentioned in the article referred to, are not denied. Two other objections are prefaced by the expression "the writer believes," which he has a perfect right to do.

The densities referred to in table 6 and called "Field densities" appear to be pole face densities, although in the article referred to they are said to be gap densities. To whatever part of the magnetic circuit they belong, they are incorrect, since they should not increase as a regular function of the capacity, and are, in fact, affected by a multitude of conditions, such as speed, form of field magnets, gap length, requirements as to regulation, temperature and so on.

The statement of the law of E. M. F. at the bottom of page 47 differs radically from the statement of the same law given in the first sentence of article 4, page 6, in that the former includes length and cutting speed of conductor, which the latter does not. The statement on page 6 is correct.

In the case of series wound armatures with cross connected commutator bars, the author of the book simply misconceived the object of the cross connection. Each commutator segment is connected to one end of an armature coil, and each bar has exactly the same functions to perform; and therefore none of them is extra, but each in turn is concerned in commutation while under the brush.

The sensitiveness of iron to changes of magneto-motive force depends on its previous magnetic history, being more sensitive to increase of magneto-motive force on the ascending leg of the hysteresis curve and to decrease on the descending leg. If the author's statement were true, a small m. m. f. could be made to produce a very high density by being applied and removed a number of times, each application increasing the density more than the removal would decrease it.

In the first paragraph of page 34 increased diameter is said to allow of a decrease in the depth of the winding, which only applies to smooth core machines, to which the author does not limit the statement.

In regard to the review as a whole, it was written at your request, and after a careful study of the book. I have had no reason to change my opinion since that review was written.

THORBURN REID.

New York City, March 28, 1898.

W. J. Clarke's Lecture on Wireless Telegraphy.

IN his interesting lecture on Marconi's system of wireless telegraphy, delivered March 30, 1898, before the New York Electrical Society, Mr. W. J. Clarke stated that the electric waves caused no noticeable motion of the filings in the coherer, that is, none apparent to the eye even when aided by a powerful microscope (2,000 diam.). And this is not surprising. Why should they move?

The diminution in the ohmic resistance might be explained as follows: The ether waves induce an electric charge which breaks down the resistance of the dielectric between the particles in the coherer, and establishes minute arcs whose resistance is comparatively very low so that they are easily maintained by the battery in circuit. When the waves discontinue the jarring of the decoherer sets the air in the coherer in violent agitation, sufficient to blow out the arcs and thus raising the circuit to its initial high resistance.

To verify, or perhaps disprove the above theory, I would suggest that the coherer be examined in the dark and also a chemical examination of the contents of the coherer might be made after it had been in use for some time.

RICHARD KOCH.

April 1, 1898.

NEWS AND NOTES

Electrical Preparations for War.

THE Government is in correspondence with the General Electric Company relative to the cost and time of equipping every fortification along the Atlantic and Gulf Coasts with powerful searchlights, and it is believed that the contract will be let shortly. The contract will involve the expenditure of over a quarter of a million of dollars, as all the fortifications would have to be supplied with dynamos to furnish power for the lights. Should the occasion demand, the fortifications could all be equipped with lights in about four months.

The General Electric Company, which is constructing the electrical apparatus for the cruisers "Kentucky" and "Kearsarge," is pushing the work with all possible speed. These ships will be the first to be equipped with electrical moving turrets and hoisting machines. The General Electric people expect to complete the contract in about a month's time.

As a result of representations made by Capt. James Allen, signal officer stationed at Governor's Island, to Brigadier General A. W. Greely, Chief Signal Officer, of the absolute necessity of the expenditure of more than $25,000 in the telephonic and telegraphic connection between the fortifications in New York harbor, New York will get $25,000 more to complete thi work according to the original plans. Boston will get about $10,000, Philadelphia about $5,000, and Washington, Baltimore, Newport, and Portland, Me., will also get increased appropriations. The total increase for the Department of the East is $96,000. This increased appropriation will make it possible to do an especially important work. All coast fortifications are provided with range finders for the purpose of determining the distance from the fortification of an enemy's vessel. These, if they are to be used effectively, must be supplemented by telegraph apparatus, to enable the man in the tower to telegraph to the gun pits the range of the approaching vessel. The majority of the range finders in the fortifications are now so equipped. Now every one will be so within thirty days.

Both the War and Navy Departments have recently placed "rush" orders in Chicago for telephone supplies for coast forts

and navy yards. All orders have been marked "emergency purchases," indicating that the supplies were to be paid for out of the fund placed at the disposal of President McKinley by Congress. A full telephone equipment has been shipped to Pensacola, Fla. The points for which the telephone equipments are destined embrace all coast defense forts, and it is the intention of the Government to connect these with each other and all with Washington. The apparatus was supplied by the American Electric Telephone Co., of Chicago.

From one of Gen. Merritt's staff officers it has been learned that the Western Union and the Postal Telegraph companies have begun to organize corps of skilled electricians, whose services are to be offered to the Government should war be declared. The Postal Telegraph Company has already organized three companies of fifty men each in New York and an equal number in Boston for this service. The particular work expected of the men is the laying of submarine cables and connecting them with submarine mines and torpedoes. Every man in each company has been provided with a kit of tools, which, under orders, he carries with him day and night. The men have been informed, it is said, of the service expected of them, and they have been informed that, should war be declared, they would draw their salaries from the company as well as their pay from the Government.

The Safety Insulated Wire Co., of New York City, has been extremely busy on its rush order for cables for the Government, and has been working night and day to get the cables made and shipped. A lot more wire and cable has been called for, and contracts were to be awarded Monday, April 4. The specifications call for twisted pairs ærial wires, twisted pairs underground cables, lead covered, and a three conductor, lead-covered underground cable. Those who bid for the work must state the shortest possible time in which they can furnish five-mile lots of the wire and the cables. The bids must also state how soon after the delivery of the first lots 100 additional miles of ærial wire, in five-mile lots, can be delivered, and how soon sixty miles of the underground lead-covered cables and twenty miles of the three-conductor underground cable, each in five-mile lots, can be delivered. In awarding the contract, quickness in delivery will be considered quite as much as the price.

Most of the cable and wire will be used in connecting the range finders with the gun pits in the different forts. Some of it, however, will be used in connection with the work of mining the waters about a few of the fortifications.

Capt. Eugene Griffin, vice-president of the General Electric Co. and formerly of the U. S. Engineer Corps, has been in close consultation with the authorities in Washington. He has busied himself the last few days in organizing here an electrical corps from the ranks of the General Electric Co. and the New York Edison Co., as well as in organizing similar staffs at other Atlantic ports.

The Brooklyn Edison Co., secretary Royal C. Peabody, reports, is in readiness to aid the Government with searchlights and current for same, all along the Eastern shores of the Lower Bay, as far out as beyond Coney Island.

The East Pittsburg shops of the Westinghouse Electric and Manufacturing Co. are rushed with Government orders for electrical instruments and firing apparatus for submarine mines. Electrical automatic machines for the control of floating mines, torpedoes and signaling under water are included in the order. A new machine designed by Lieut. A. C. Engard, of the engineering corps of the navy, for the management of torpedoes, is being made, and it is said that it is unexcelled for accuracy, rapidity and destructiveness.

The Walker Co. at Cleveland has been busy on Government work, including orders for gun carriages.

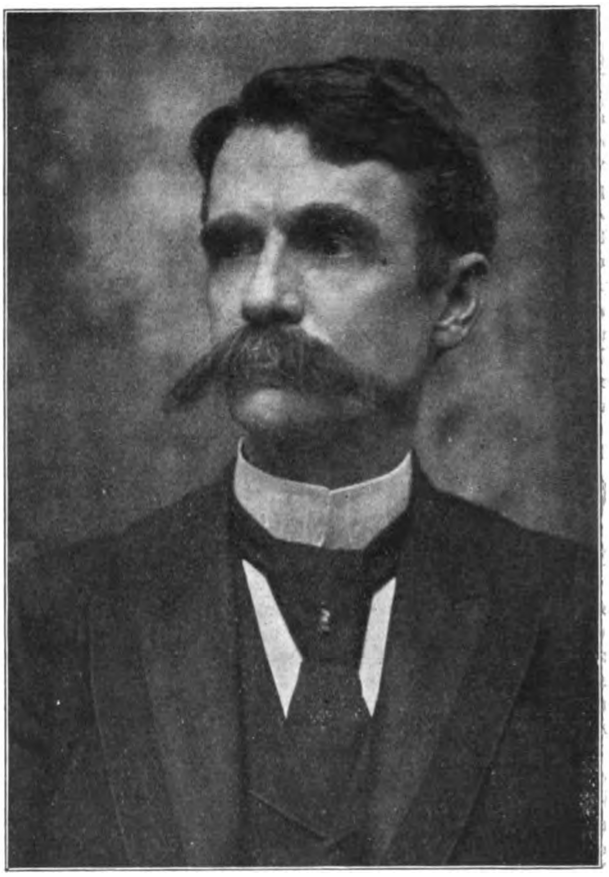
THE "MAINE" REPORT bears emphatic testimony to the fact that the electric light plant was all right in every respect. Lieut. G. M. F. Holman, who was in charge, testifies that the shock was precisely similar to many other submarine explosions he had heard. The electric wires were separated from the magazine by a double plating of glass, and there was nothing unusual about the temperature of the dynamo room.

A PROTEST. In three days, over 4,000 telephone subscribers in Massachusetts protested against the bill to put the telephone companies of the State under the control of the gas and electric light commission.

PERSONAL

Mr. W. D. Sargent.

THE fact that the New York and New Jersey Telephone Company is just marking another stage in its rapid growth by the occupancy of its fine new telephone exchange building, recently illustrated in these pages, directs interest to the personnel of the management, and especially to Mr. William Dunlap Sargent, vice-president and general manager. This gentleman is well known and highly esteemed in telephone circles. He was born in Pennsylvania, and entered the telegraph service of the Pennsylvania Railroad Company at the beginning of the war. He served for a brief period during the war in the United States military telegraph department of General Burnside at Cincinnati, and afterwards entered the service of the Western Union Telegraph Company, serving as operator, manager and assistant electrician. In 1873 he was superintendent of the original organization of the American District Telegraph in Philadelphia, and in 1877 became associated with Mr. Thomas E. Cornish, of Philadelphia, in the organization of the Bell Telephone Company, of Philadelphia. In 1882 he accepted a position with the New York and New Jersey Telephone Company, Brooklyn, since which time he has been uninterruptedly connected with the telephone service. Mr. Sargent's long and varied experience in the various branches of electrical service makes him, and he is considered as one of the leading telephone engineers of the country. He is a member, in Brooklyn, where he lives, of the Riding and Driving, Montauk and Brooklyn clubs. He is also a member of long standing in the American Institute of Electrical Engineers. We are indebted to "Brooklyn Life" for the excellent portrait herewith presented.



WILLIAM DUNLAP SARGENT.

PROF. S. H. SHORT has recently given a syndicate writer for a large number of papers a very interesting article on novel and possible uses of electrical methods in warfare.

REPORTS OF COMPANIES

Annual Report of the American Bell Telephone Co.

THE annual meeting of the American Bell Telephone Company was called to order in Tremont Temple, Boston, on March 29. President John E. Hudson read the report to stockholders, and the treasurer's statement. The election of officers resulted as follows: Clerk, Charles Eustis Hubbard; treasurer, William R. Driver; directors, Charles W. Amory, Thomas B. Bailey, Francis Blake, George L. Bradley, Alex. Cochrane, T. Jefferson Coolidge, Jr., J. Malcolm Forbes, Henry S. Howe, Charles Eustis Hubbard, John E. Hudson, Charles E. Perkins, Thomas Sanders, Moses Williams.

The annual report issued to the stockholders showed that the number of instruments in the hands of licensees, under rental, Dec. 20, 1896, was 772,627; Dec. 20, 1897, 919,121; increase, 146,-494.

The working statistics, Jan. 1, 1898, and the increase since Jan. 1, 1897, are as follows: Exchanges, 1,025; increase, 58; branch offices, 937; increase, 105; miles of wire on poles, 327,315; increase, 40,683; miles of wire on buildings, 13,776; increase, 1,182; miles of wire underground, 282,634; increase, 47,833; miles of wire submarine, 2,675; decrease, 143; total miles of wire, 626,400; increase, 89,555; total circuits, 295,904; increase, 31,259; total employés, 16,682; increase, 2,257; total stations, 384,230; increase 48,986.

The estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, is 3,099,472, or a total per year of about 998,000,000.

The number of daily calls per station varies in different exchanges from 1 7-10 to 18, the average throughout the United States being 8 1-10, which is the same as the number reported last year.

The average cost to the subscriber by exchanges varies, according to the size of the exchange and character of the service, from less than 1 to 9 cents per connection.

Extra territorial and toll lines—Miles of pole lines, Jan. 1, 1898, 67,791; increase, 7,238; miles of wire, 324,88,; increase, 56,017.

The average daily number of toll connections is 75,208, or a total per year of about 24,200,000.

The total revenue reported by all companies for the year 1897 was $4,435,515.40, and the earnings of extra-territorial lines included in the above sum amounted to $1,949,132.61. Of the last amount this company received $211,507.21, an increase over 1896 of $29,241.89, not including earnings of the American Telephone & Telegraph Company.

The output of telephones and the increase of the number of exchange subscribers reported by the companies operating under our licenses are unprecedented in the history of the business. In fact, the gain of exchange stations recorded for the past two years equals the aggregate gain of the six years which preceded.

The system of measured service continues to grow in public approval. The subscriber pays for the specific number of outgoing exchange connections for which he contracts, or as many more as his needs require, and is at no expense for inward calls. This system of charges, based upon the amount of usage, is doubtless the more logical one, and its introduction has resulted in extending the service of the telephone to large numbers who would not otherwise have employed it as regular subscribers. While it supplements most usefully the older system of commutation, or unlimited service at yearly fixed rates, it is not likely to supersede it, for there will always remain a large proportion of the subscribers whose wants can be met only by the unrestricted use of their own circuits, with the right to call into requisition, as often as they desire, the circuits of other subscribers to the exchange, as well as the system of trunk lines which are necessary, in the great cities, to connect the numerous offices into which the exchange is divided. With the increase of the number of subscribers in an exchange, it is obvious that this right of unrestricted use becomes of larger consequence and of larger value. Much is to be said, therefore, in favor of the retention of both systems together, as contributing, in the largest degree, to the interests of those who regularly employ the telephone in the conduct of their affairs.

During the year the long distance company's lines have been extended to reach Omaha in the West, Minneapolis to the North, and southerly to Petersburg and Norfolk. There were in operation Jan. 1, 1898, 8,778 miles of pole line and cable, and 116,116 miles of wires connecting 238 offices; a gain during the year of 1,433 miles of pole line and cable, 8,706 miles of wire, and 55 offices.

The new construction completed in 1897 by companies with which we have contract relations, amounted to $8,712,914.10. Of this sum, $4,865,317.92 was expended upon exchange construction and equipment, and $3,847,596.18 upon toll lines. In addition to the above, $1,484,331.71 was invested in real estate to be used for company and exchange purposes. The entire expenditure for construction, including real estate, to the close of 1897, has been $85,946,102.27.

The Long Distance Company had invested, up to Dec. 31, 1897, in line construction, franchises, equipment, and supplies, $13,888,751.81. The company shows an increase in gross earnings in 1897 over 1896 of 16.1 per cent., the amount for 1897, gross, being $1,897,293.95.

The statement of Treasurer William R. Driver is as follows: The ledger balances, Dec. 31, 1897, were:

DEBTORS.

Telephones	$1,772,596.55
Real estate	1,052,695.92
Stocks and bonds	52,287,205.59
Merchandise and machinery	18,319.68
Bills and accounts receivable	3,275,059.70
Cash and deposits	1,833,964.11
Total	$60,779,841.55

CREDITORS.

Capital stock	$25,886,300.00
Capital stock premium account	6,110,582.00
Debenture bonds, 1888	2,000,000.00
Bills and accounts payable*	1,216,330.89
Patent account (profit and loss)	12,399,047.16
Profit and loss	6,551,431.94
Reserve	4,025,628.29
Surplus	2,590,521.27
Total	$60,779,841.55

*Of this amount $1,164,883.50 is for the dividends payable Jan. 15, 1898, to stockholders of record Dec. 31, 1897.

The comparative statement of earnings and expenses is as follows:

EARNINGS.

	1896.	1897.
Rental of instruments	$1,238,378.03	$1,597,959.36
Dividends	2,616,307.00	3,085,379.00
Commission from ex-terr. lines	182,265.32	211,507.21
Commission from tel. business	34,046.88	33,174.32
Real estate	80,864.38	84,709.85
Interest	171,355.23	117,071.93
Miscellaneous	4,107.41	1,043.25
	$4,327,324.25	$5,130,844.92

EXPENSES.

Expenses of operation	$409,052.31	$509,314.02
Legal expenses	100,744.78	136,333.49
Real estate	40,117.87	41,560.76
Interest and taxes	303,731.38	273,961.92
Miscellaneous	97.47	......
	$943,743.81	$961,170.19
Net earnings	$3,383,580.44	$4,169,674.73

Surp. acct., Dec. 31, 1896	$2,151,011.61	
Net earnings, 1897	4,169,674.73	
		$6,320,686.34
Regular divs., 1897	$2,939,904.00	
Extra divs., 1897	743,044.50	
Reserve for depreciation of insts.	47,216.57	
		3,730,165.07
Surp. acct., Dec. 31, 1897		$2,590,521.27

Bell Telephone Output for March.

The American Bell Telephone Company's monthly statement of the output of instruments for the month ended March 20, with comparisons, is as follows:

	1898.	1897.	Changes.	
Gross output	28,909	19,192	Inc.	9,717
Returned	15,737	6,495	Inc.	9,242
Net output	13,172	12,697	Inc.	475
December 21 to March 20—				
Gross output	80,667	53,309	Inc.	27,358
Returned	38,566	20,911	Inc.	17,657
Net output	42,099	32,398	Inc.	9,701
Total outst'd March 21	962,792	804,687	Inc.	158,105

ELECTRICAL EXHIBITION. FROM MAY-2 TO MAY-31-

Edison Magnetic Ore Separation.

A great deal of public interest attaches to the work which Mr. Edison has been doing for some time past in magnetic ore separation, and the general curiosity on the subject will be satisfied at the approaching Exhibition, where Mr. Edison will kindly loan a model built for him by Mr. Sigmund Bergmann, which illustrates admirably the fundamental principles of the process. This model will be kept running by a small motor, and the iron will be continuously separated from the crushed rock in full view. Mr. W. S. Mallory, the manager of Mr. Edison's mining work, is sending to the Exhibition samples of crushed rock in its various stages, as well as samples of the separated ore, and of the briquettes which are sent to the furnace. He is supplementing this with some 4 or 5-ton masses of rock, which Mr. Edison takes bodily out of the hillside, by means of huge excavators, and the magnetic condition of these ponderous masses will be shown and tested by magnets. Around the exhibit will be placed photographs illustrative of the scenes at the mines themselves, and the whole will constitute one of the most instructive demonstrations possible. This valuable exhibit will be placed along one side of the Concert Hall of the Garden, in company with a number of very interesting special features which have already been arranged for.

OBITUARY

Daniel Andrews.

The death is announced of Mr. Daniel Andrews, president of the Hamilton, O., Gas Light and Coke Co., and the Hamilton Electric Light Co. He had not long been a resident of the city, but had made himself prominent and respected. The main cause of death was pneumonia. He was in his sixty-seventh year, and leaves a wife and four children.

Edward B. Knowles.

Every one in the electrical field will feel deepest regret at the terrible bereavement that has fallen suddenly upon Mr. E. R. Knowles, the well-known electrical engineer, in the sudden death of his son, Edward Knowles, aged only 20. The two were out together on Sunday morning at Bensonhurst, Long Island, wheeling, when the handle bar of young Mr. Knowles's wheel became loose, and he was thrown, breaking his collar bone and injuring the brain. He was taken home by his father in a carriage, and died during the afternoon. The youth was himself an electrician and had done work of great promise in various directions, particularly in the branch of arc lighting, in which he had made several valuable improvements, now in actual use.

LEGAL NOTES

Litigation on Alternating Current Motors.

THOMSON-HOUSTON CO. VS. WAGNER CO.

We are informed that suit has just been brought in the U. S. Circuit Court, Southern District of New York, against the Wagner Electric Manufacturing Company, by the Thomson-Houston Electric Company. The bill of complaint alleges infringement of the Thomson alternating motor patent No. 430,-328. The first claim of this patent reads as follows:

"1. The herein-described method of operating an alternating current motor in which the rotation is produced by the reaction between the field and a locally-closed armature circuit carrying currents induced from the field, consisting in organizing or connecting the motor armature circuit so that it may receive an initial impulse of rotation, and upon the attainment of a predetermined speed changing or modifying such connections, so as to put the armature coils on locally-closed circuit."

The Wagner self-starting single-phase motor is started by placing the armature in series with the field coils and at running speed the commutator is short-circuited. It is understood that the suit is directed particularly against this motor.

Firman Telephone Switchboard Patents.

We are in receipt of the subjoined item from the Western Telephone Construction Co.: "The attorneys for the Western Electric Company (Bell telephone manufacturers) having published a statement, over their signature, which, by inference, indicates that the Firman patent covers all forms of multiple switchboards, and that this patent was upheld in their favor in a recent California suit, we desire to publicly announce that the Firman patent does not, in any manner whatsoever, affect the multiple transfer system of the switchboard of this company. We challenge a single particular in which the Firman patent claims refer to our devices."

THE STOCK MARKET

Steady but Nervous.

Though much beset by war worries, the stock market has shown remarkable strength and while it would rally very emphatically on news of peace, it may be doubted whether it would go much lower if war were actually declared, for then the wearing uncertainty would be over. Meantime general trade continues good, with almost every condition full of encouragement.

During the past week, 25,459 shares of Western Union were sold at prices between 85½ and 84¾. Of General Electric, 17,270 shares were sold, down to about 32. In Boston, American Bell Telephone advanced from 241 up to 250 on sales of 804 shares. New York Edison advanced from 120 to 124.

Copper is quoted at 12 cents; heavy steel rail, Eastern mill, at 18 per ton. It is said that managers of the large steel works are beginning to express fears as to a coming scarcity of Bessemer pig iron.

PAUL BOURGET. No one who is interested in the best contemporary French literature can afford to miss the series of sketches and stories by Paul Bourget, which will begin in The Living Age for April 2. These sketches have been but recently published in France, and this is their first appearance in English dress. They are translated for The Living Age by William Marchant. They are extremely clever and characteristic.

ELECTRICAL MATERIAL of all kinds in large quantities has lately been purchased by the U. S. Government, chiefly for purposes of coast defence. Gen. A. W. Greely, chief signal officer, wants more immediately.

TRADE NOTES & NOVELTIES

Western Electric Column and Tuerk Ceiling Fans.

THE Western Electric Company's column fans, illustrated in Fig. 1, have but two speeds, 150 and 175 r. p. m., and are made with or without polished red birch tables, all metal work being finished in polished brass or oxidized copper. The motors are furnished with a switch, while the lights are controlled by a switch placed on the under side of the table. The tables can be furnished either square or round and are four feet in diameter.

Special attention is called to the Tuerk alternating current fan motor, shown in Fig. 2, which is furnished with two blades and is designed to be operated on a current of 60, 125 or 140 cycles, at 52 or 104 volts. This motor will be furnished finished in bronze, Bower-Barff, nickel, brass or white and gold. All shafts are mounted on self-oiling bearings. A switch is provided for starting and stopping the motors. By a very ingenious device the angle of the blades may be so shifted that the wind may be blown downward towards the floor or upward towards the ceiling. The motors are of the reduction type. A reduction in speed is obtained by the introduction of leather-faced friction wheels by means of which the motors are rotated at a slower speed than that of the armature; this device enables the use of a highly efficient, high speed, alternating current motor, obtaining all of the desired results of the slow speed fan.

A very handsome catalogue has been issued, describing in detail all of these motors and will be furnished upon application.

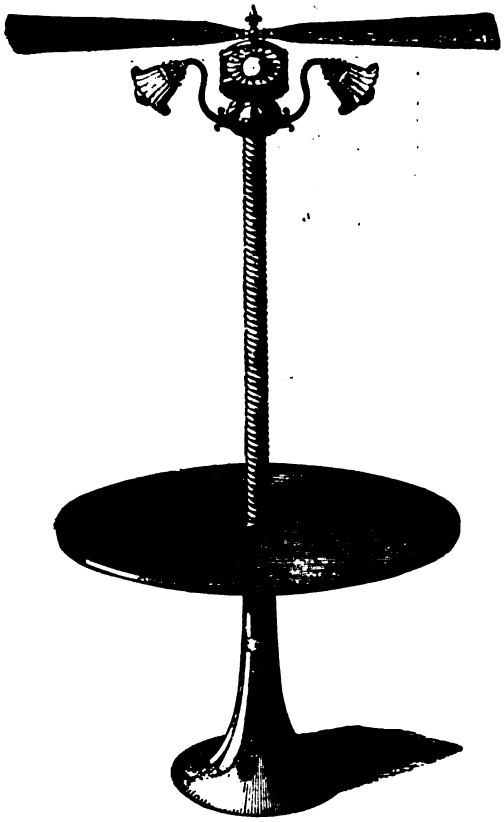


FIG. 1.—W. E. COLUMN FAN.

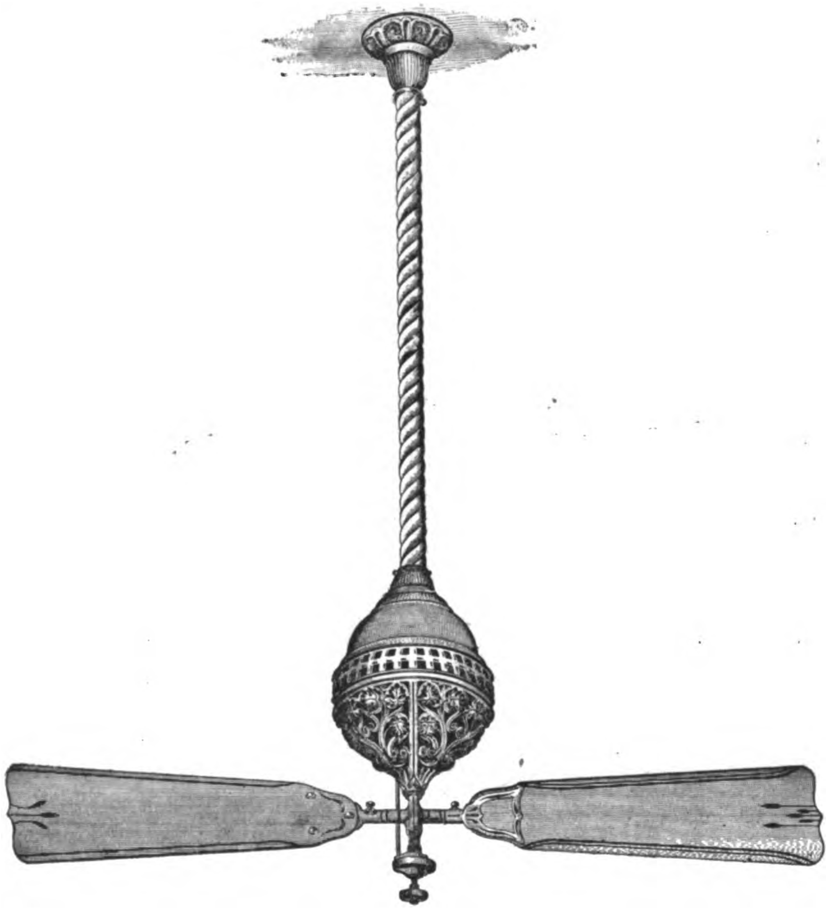


FIG. 2.—W. E. "TUERK" ALTERNATING CURRENT CEILING FAN.

PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., have orders enough on hand to keep them extremely busy. Their porcelain insulators are finding an excellent market in both this and foreign countries.

Huge New Foundry For the General Electric Co.

THE General Electric Company, in view of the constantly growing demand for apparatus of its manufacture, has decided to make a large increase in its manufacturing facilities. On March 25, the company placed contracts for the construction at its Schenectady works of a new foundry, which will be one of the largest in this country. The present foundry has been for some time entirely inadequate to meet the demands upon it, and considerable work has been passed on to the admirably equipped foundry which the company has at Lynn. The work to be done has, however, grown even beyond the capacity of both the Lynn and Schenectady foundries, working overtime, and all is now to be concentrated in the new foundry, construction of which is to be begun immediately.

The building will be of brick, 500 feet long and 140 feet wide, with an "L" 100 feet by 120 feet. The latter will be used as a cleaning shop. Besides these main buildings, a number of sand sheds, several smaller buildings for the storage of foundry material, and a new pattern storehouse 200 feet long, 60 feet wide and two stories high, will also be erected. All combined, the floor space occupied will be about 12,000 square feet. Plans are also under consideration for a new machine shop 650 feet long by 165 feet wide, but the appropriation for this has not yet been authorized.

The buildings will be erected on the property which the General Electric Company recently purchased from the Gilbert Car Works. It lies to the west of the present works and parallel with the Erie canal. The foundry will be built several hundred feet from the canal and will be in close proximity to the sand sheds and pattern storehouse. Every precaution will be taken to eliminate risk from fire; indeed, the pattern storehouse will be made as absolutely fireproof as possible. The foundry as laid out will be a model of the most approved modern practice. Careful thought and study have been given to the matter, and the engineers of the company have drawn on the experience of other companies which have recently constructed foundries. The building will be of imposing proportions and will be in plain view from the New York Central tracks.

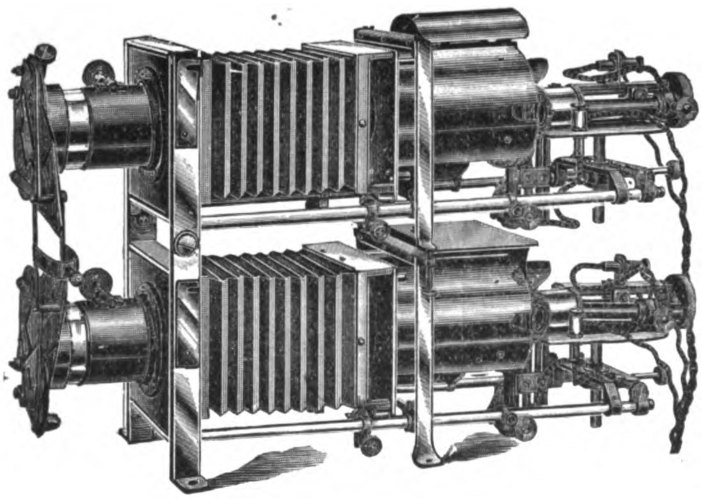
The contemplated machine shop will be built on Central ave-

nue opposite building No. 15, and will be devoted almost entirely to very large machine work. The size of the great generators which the General Electric Company has been manufacturing has of late been increasing until, to-day, a generator of 4,000 h. p. is not now regarded as of unusual size. In fact, generators of 5,000 h. p. are now in course of design, and the demand upon the shop in which the large machinery has heretofore been built has far outgrown its present proportions.

The middle aisle of the new machine shop will be 65 feet wide, with narrower aisles down each side. Electric traveling cranes will be installed to operate along each aisle and a gallery will be built along one side only. All the large machine tools will be removed from their present locations to the new shop, their places being taken by smaller apparatus. The total floor space of this building will amount to not less than 144,250 square feet.

The "Ideal" Electric Light Stereopticon.

AN illustration is shown herewith of the "Ideal" electric light stereopticon, which has been placed on the market by the inventors and manufacturers, A. T. Thompson & Co., 26 Bromfield street, Boston, Mass. The cut gives an excellent idea of its appearance and mechanism. It is one of the most compact stereopticons operated by arc lamps now obtainable, and, being supplied with every known improvement for the correct and rapid exhibition of lantern slides, it commends itself to all who may desire a first-class apparatus at a moderate price. The arc lamps are of novel design and construction, inasmuch as the carbons are arranged on the 90 degree plan, thus securing an increase of nearly 25 per cent. in volume of light over the old way of placing carbons in the perpendicular form. These lamps will burn two hours without changing carbons, and 15 minutes without turning the adjustment wheel. They may be used on either the direct or alternating system of lighting, a double set of gears being fitted to each lamp. The change can be made from one system to the other in one minute. Every lamp is tested for 50 amperes, or five times the usual amount of current passed, and



THE "IDEAL" ELECTRIC LIGHT STEREOPTICON.

the insulation will stand 500 volts indefinitely without injury. The metal hood which nearly surrounds the arc answers a double purpose, inasmuch as it excludes all light from the room and absorbs the heat and dissipates the same to other points than the condensing lenses. Peep holes in these hoods, covered with mica, enable the operator to examine the arc at all times. Another novel feature of this apparatus is the mechanical shutter, by the use of which dissolving effects are produced equal in every way to those obtained by the lime light.

Provision has been made for the use of the microscope and attachment, vertical attachment with lenses, water cells, etc., for chemical and physical laboratory use. The slide carrier and bellows are detachable at the condensing lenses, thus providing space for the introduction of the above mentioned apparatus. The bellows have a sufficient extension for the use of objective lenses varying in focus from 3 to 12 inches. The whole apparatus is finely finished in nickel with burnished brass trimmings, and the general construction is such that with ordinary care it should last a lifetime.

The lanterns are provided with microscopic registering devices, both horizontal and vertical; hence it is possible to exhibit any mechanical effects with perfect accuracy. Messrs. A. T. Thompson & Company will be glad to receive and answer any inquiries with regard to this specialty or any of their other optical and projection apparatus.

The New Edison Fan Motors.

THE problem of designing a fan motor, which shall give good ventilation, and shall also run economically by battery power, is one that has engaged the serious attention of the whole electrical world, and we are pleased to be able to record some very great advances which have recently been made in this direction. The Edison Manufacturing Co., of New York and Orange, N. J., are placing on the market a battery fan outfit which is greatly superior to anything they have produced up to the present time. The 9-inch battery fan outfit, manufactured by this concern, deserves special notice.

The motor is of the Paccinoti ring type, and runs on ball bearings. A series of most elaborate tests (extending over several months) were made, before this innovation was finally decided upon, and the results obtained fully justify the change which

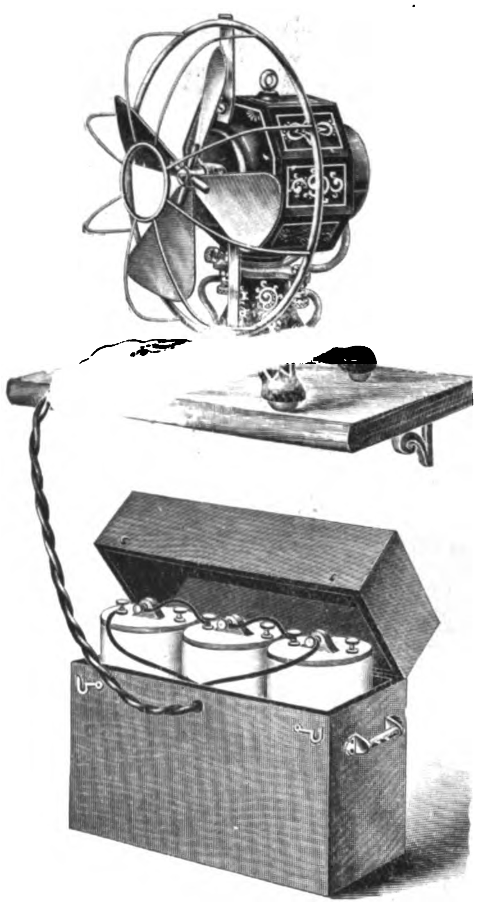


FIG. 1.—EDISON FAN.

has been made. When this outfit was first placed on the market, some five years ago, the motor had a 6-pole armature, and a battery consisting of four Edison-Lalande cells, type "S," in oak box, which ran the motor for 100 fan hours, at a speed of about 700 revolutions per minute, before needing to be renewed.

In the spring of 1897 a new motor was designed, having a Paccinoti ring armature, which was considerably more efficient than the old style motor, as the working current was reduced so that the battery would last for 125 fan hours, and the speed of the fan was increased to about 800 revolutions per minute.

The new ball bearing motor which is now furnished with this outfit takes only 1.75 amperes of current, and runs the fan upwards of 850 revolutions per minute. As the capacity of the battery is 300 amperes hours, it follows that it will run the fan for 170 fan hours before needing renewal. It will thus be seen that the efficiency of the new motor in saving of battery power, is 33⅓ per cent. over that of the 1897 model, and 70 per cent. over that

of the original model. This does not take into account the increase in speed of the fan from 700 revolutions per minute to 850 revolution per minute, which is even more remarkable.

The Edison iron-clad battery fan outfit, manufactured by the same concern, has also been greatly improved. The motor, which carries a 7-inch fan, and is furnished with three Edison-Lalande cells, type "S" (300 ampere hour capacity) in an oak box, has been greatly simplified in construction. The improvement consists in the substitution of a small drum commutator for the disc commutator, formerly used, and the extension of the rear shaft support (carrying the brushes) beyond the iron-clad field, so as to enable the brushes to be easily adjusted. The motor

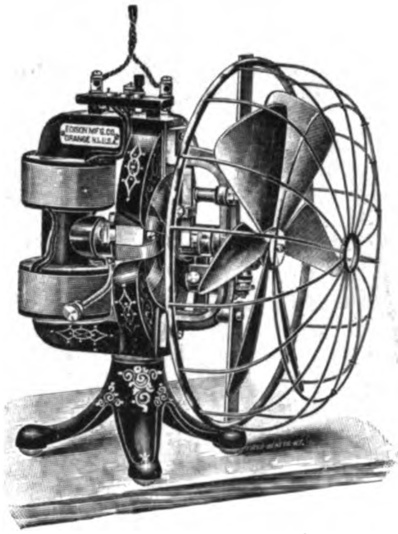
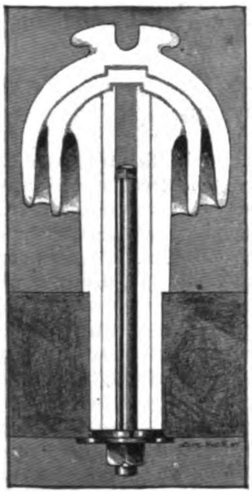


FIG. 2.—EDISON FAN.

runs the fan at 1,200 revolutions per minute, and the battery will last for 150 fan hours before being exhausted.

The great success that has attended the exploiting of both these battery fan outfits, has induced the Edison Manufacturing Co. to enter the field of the 110 volt direct current fan motors, and they are now placing on the market a very satisfactory fan motor for this current, furnished with 12-inch fan and guard. This motor is similar in construction to the 9-inch Edison battery fan motor, but is furnished with a three-speed switch, running the fan at 1,000, 1,200 and 1,400 revolutions per minute, respectively. The efficiency of this instrument is very high, and the workmanhip of all the outfits is of the very finest grade.

New Style Boch High Potential Insulator.



IN our issue of March 24, we described a method of manufacturing highly efficient petticoat insulators, the invention of Mr. J. W. Boch. The method of "glazing" described in that article has now been applied by Mr Boch in the manufacture of the insulator shown in the accompanying illustration. In the construction of this insulator, porcelain is used for both the body and the post. The petticoat body is made in two or more parts, each petticoat being like an inverted bowl, with the smaller one nested into the larger one. The central portion constitutes a third part of the insulator. These three parts are secured together either during the process of vitrifaction or in the glazing, in order to make it equal in strength to a single homogeneous piece. The supporting post is at its lower end adapted to enter an opening made in the cross-arm, and an annular shoulder is formed on the post to rest on the cross-arm and form a point of support. The vertical opening in the support is of a diameter suitable to receive the metal securing pin which extends up into the post to any desired height, and is secured by a suitable cementing composition. A nut and washer complete the means for holding the whole in place on the cross-arm.

These insulators have been placed on the market by the R. Thomas & Sons Co., of East Liverpool, Ohio, with sales offices at 39 and 41 Cortlandt street, New York. Wherever installed they have given entire satisfaction.

Sprague House Elevators.

The Sprague automatic house elevators are being received with a great deal of favor, and many wealthy men of New York City and elsewhere are placing them in their houses. The machine embodies a number of highly ingenious features in its method of control, which is entirely automatic. By means of its devices, the machine may be operated from any floor, or from the car itself. By merely pushing a button from any floor, the car is brought to that particular floor without any further manipulation of the controlling apparatus, and when a door is opened, it is impossible to operate the machine from any other point, or until the car has reached its destination, and the landing door is finally closed. While the car is in operation it is impossible to operate any of the buttons aside from the one initially connected, and there is also a mechanical locking device at each door preventing its operation except when the car is at the corresponding landing. The simplicity and absolute safety of this machine is the great reason for its success.

The M. R. Rodrigues Mfg. Co.

The M. R. Rodrigues Mfg. Co. has recently been incorporated under the laws of the State of New York to manufacture electrical motors and appliances, and will be located after May 1 at Nos. 10 to 14 Whipple street, Brooklyn. The company is formed by Mr. M. R. Rodrigues and Mr. A. T. S. Clarke. Mr. Rodrigues is well and favorably known because of his long connection with the electrical field not only in the manufacturing line, but in many electrical associations; and it is due to his untiring energy that he has been able to build up for himself a very profitable manufacturing business during the number of years he has been engaged in this work. The new quarters of the company are beside the old location and are about twice as large as the old factory. A lot of machinery will be installed, and with the additional room secured the manufacturing end of the line will be prosecuted vigorously. Prompt shipments are assured.

The Peru Electric Manufacturing Co.

In 1892 a company including many of the most influential citizens of Peru, Ind., was organized with a capital stock of $100,000, for the purpose of manufacturing and placing on the market a line of electrical supplies, and it was known as the Peru Electric Works. In the latter part of 1893 fire wiped away the large porcelain building, and as the Dow plant across the railroad track was idle an offer for the buildings was made and accepted. After some alterations and repairing the move was made and the force of employés increased. Each year the company has seen its business grow larger and new buildings go up to accommodate the demand for more room. Although it now has one of the largest and most complete institutions of its kind in the country, it is again preparing for the erection of another large building. This will be twenty-five feet wide and seventy feet long. Forty-five feet of the building will be one story high, while to the other twenty-five feet a second story will be added. The structure, which will be located north of the large two story brick building in which the clay bins and press room are at present, will be made of brick with a fireproof roof. The clay bins will be moved into the new building and the space made vacant will be filled with porcelain presses. The two story part of the new building will be made fireproof to contain all the dies used in the business.

A porcelain kiln, surrounded by an ironclad building thirty feet square and one story high, has just been completed and will soon be pressed into service. This makes five kilns for the works. At present the company is enjoying a boom in trade and has a force of at least a hundred persons at work. The plant is one of the most thriving in the city. The present officers are: J. O. Cole, president; C. H. Brownell, vice-president; R. H. Bouslog, secretary and treasurer; R. A. Edwards, J. O. Cole, C. H. Brownell, J. G. Brackenridge, William Levi and William B. McClintic, directors.

The Diehl 1898 Electric Fans.

THE Diehl Manufacturing Co. of Elizabethport, N. J., who were the originators of suspended fans using a self-contained motor, have for many years maintained the high standard of their product by the introduction of improvements whenever possible. Their desk fans, illustrated in Fig. 1, were placed on the market last season, and met with instantaneous success. They are of the highest efficiency, due largely to an unbroken magnetic circuit, which is a special feature. They are constructed of the finest material throughout. The armatures are built of laminated iron assembled on steel shafts, the coils being wound with double silk covered wire; the commutators are cut from one piece of pure copper and insulated with India mica; the bearings are made of Tobin bronze, are self-aligning, and are lubricated by means of wick oilers; the switches and speed regulators are mounted on steel frames, and the finished motors are as complete in all respects as 5-horse power machines of the most improved type. Each outfit is beautifully finished in rich black japan, tastefully ornamented. The blades, guards and trimmings are of polished brass, nickel or japan, as desired. These specifications also apply to the bracket fans, illustrated in Fig. 2, which may be clamped and adjusted at any desired angle to the side wall, the adjustment being effected by the wing nut at the bottom.

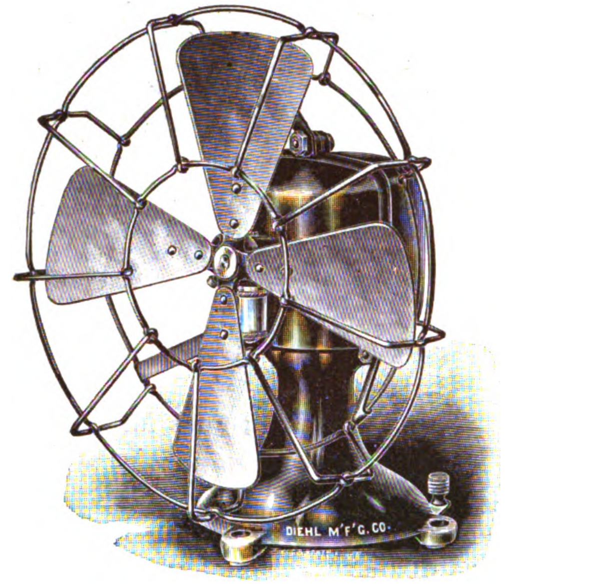


FIG. 1.—DIEHL PERFECTED DESK FAN.

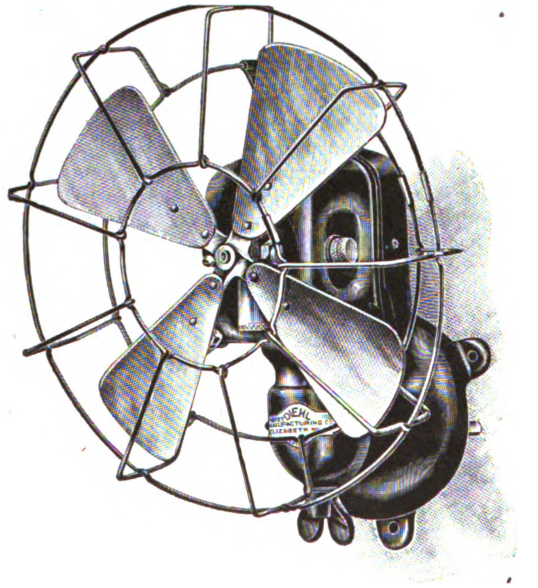


FIG. 2.—DIEHL ADJUSTABLE BRACKET FAN MOTOR.

The ceiling fans, shown in Fig. 3, present an attractive appearance and are so constructed mechanically and electrically as to appeal especially to the careful and intelligent purchaser and insure continuous service and freedom from repairs. The Diehl Company have issued a very handsome catalogue and price list, which illustrates a great variety of desk, bracket, ceiling, column and exhaust fans of any size, and wound for any voltage.

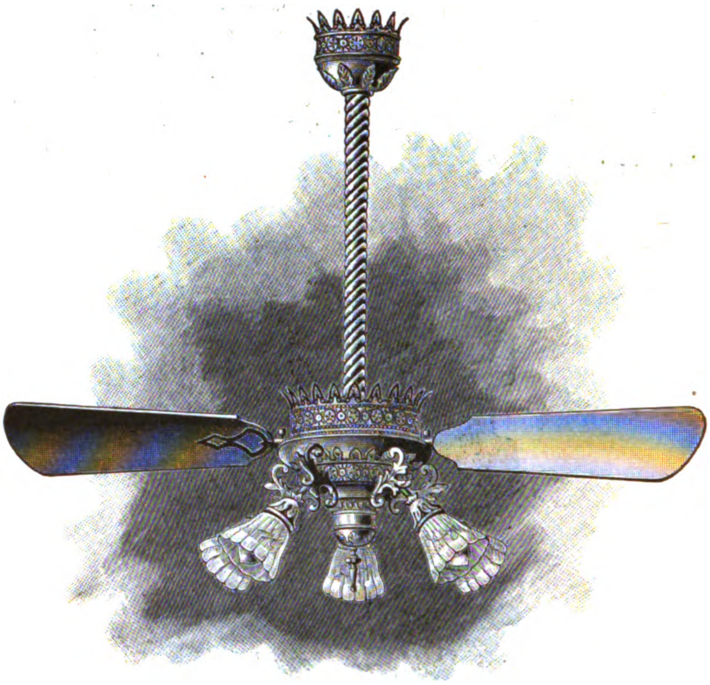


FIG. 3.—DIEHL ELECTROLIER FAN.

Tariff on Electric-Light Carbons.

The proper duty on arc light carbons under the present tariff law was the subject of a hearing on Friday last before the Board of Classification of the United States General Appraisers, in New York City. The law prescribes a specific duty upon carbons for electric lights at the rate of 90 cents a hundred, and various importers have had carbons made about a yard long, to be cut into proper lengths after being imported. The government maintained that on a thirty-six-inch carbon a duty should be levied at least three times as great as that on a twelve-inch carbon. This, however, is offset by the absurdity of such a scale in other directions, regardless of the quality or value of the carbon. Decision was reserved.

Large Orders for the Walker Co.

Among the foreign orders recently received by the Walker Co. may be mentioned: Twenty double No. 3-S street car equipments, three single No. 3-S equipments and eighteen double No. 3-N equipments for Paris, besides four 150 kilowatt belted generators with two generator panels. Messrs. Bagnall & Hilles, of Yokohama, have ordered two 25 kilowatt direct connected generators for Singapore.

Recent domestic orders include two 150 kilowatt three-phase synchronous motors for the Lachine Rapids Power Co.; a 700 kilowatt alternator, single phase, for the Buffalo and Niagara Falls Electric Light and Power Co.; two 400 kilowatt belt driven generators for the Syracuse Construction Co.; and one 120 kilokatt belted generator for the Northern Electric Co., of Baltimore. The Norton & Attleboro Railroad, of Attleboro, Mass., has purchased four double No. 4-A-S and two double No. 5-S equipments, besides a 250 kilowatt direct connected railway generator. Besides the generator above referred to, the Northern Electric Co., of Baltimore, have ordered 100 Walker arc lamps, making in all 300 in three months.

The company has also recently taken a contract from the Government to build three disappearing gun cariages for 8-inch rifles; they are to be of the Crozier type, 1896 model.

A New General Electric Enclosed Arc Lamp.

A MODIFICATION of its enclosed arc lamp has recently been perfected by the General Electric Company, which, while preserving the essential features of its well-known direct and alternating current lamps, with enclosed arcs, substitutes a flared porcelain reflector for the outer globe. The mechanism of the lamp is similar to that of the standard enclosed arc lamps, but the use of the reflector instead of the globe, allows a large amount of light which otherwise would be absorbed in the outer globe, to be thrown down by the reflector and thus utilized. Calculating this absorption of light at from ten to thirty per cent., the single globe lamp allows of the utilization of just so much of the total light from the arc, as well as that which is reflected. In cases in which the direct light from the arc is not objectionable and a general diffusion of the light not absolutely desirable, such as in cafes, hotels, restaurants, etc., the single globe is peculiarly adapted.

In designing the lower part of the frame, care has been taken

MODIFICATION OF GENERAL ELECTRIC ENCLOSED ARC LAMP.

to render it both light and delicate and yet sufficiently rigid to withstand ordinary usage, without interfering to any extent with the passage of the light or casting heavy shadows. It is highly nickeled, and thus, during the daytime, when the light is not needed, the ornamental appearance of the lamp is not detracted from. The inside of the porcelain shade is highly polished and gives a good reflecting surface. It is interchangeable and can be used with either direct or alternating current enclosed arc lamps. By an arrangement of the lower rim of the cover of the mechanism, the reflector may be substituted for outer globe of the double enclosed arc lamps. As in the direct current double globe lamps, a simple adjusting coil allows of the use of 5, 4½ or 4 amperes. By using a reflector instead of the globe, a very satisfactory light may be obtained from this lamp with a current of only four amperes. A reactive coil in the alternating lamps allows of adjustment for any line voltage between 100 and 120 volts and frequencies of 60 and 125 cycles.

The economy in carbons is the same as that obtained in the double globe lamps, and in addition the lowering of an outer globe is done away with. The globe in which the arc is enclosed is protected by wire netting.

M. B. WHEELER ELECTRIC CO. of Grand Rapids, Mich., has been formed with a capital stock of $25,000, for the manufacture of electrical supplies and specialties.

C. & C. Electric Co.

We are advised that the C. & C. Electric Company, of New York are, in spite of the war scare, enjoying one of the busiest seasons in the company's history, and that their extensive works at Garwood, N. J., are kept running night and day on orders.

During March the C & C Company took a large number of most gratifying orders of impressive proportions—enough to keep them busy for several months. Many of their recent orders have come from abroad, and the company is building up an export business which is the envy of many of its competitors.

Orders for Ball Engines.

The Jones Bros. Electric Co., Cincinnati, O., will increase their plant by the addition of a 250 h. p. tandem compound engine direct connected to a 150 kilowatt dynamo. The engine will be furnished by the Ball Engine Co., Erie, Pa., and the dynamo by the Westinghouse Electric Mfg. Co., Pittsburg, Pa.

The New Electric and Gas Light Co., of Guthrie, Oklahoma, are adding a large addition to their steam plant, and have recently ordered from the Ball Engine Co. a 175 h. p. engine, boiler and heater.

The Horne Building, of Pittsburg, which was burnt about a year ago, is being rebuilt on a more magnificent scale. The electric light plant will be large and complete. Two vertical cross compound engines, furnished by the Ball Engine Co., are being installed. These engines are direct connected to Siemens-Halske Electric Co. generators, and the whole outfit is a very handsome one.

Large Building Contract In St. Louis.

Contracts have been placed for the mechanical and electrical equipment of the large mercantile building now being erected on the north side of Washington avenue, between Ninth and Tenth streets, St. Louis, by the Commerce Realty Company. This building has been leased for ten years, beginning June 1 next, to the Hargadine-McKittrick Dry Goods Company. The contract for steam equipment, which has been awarded to the Kupferle Bros. Mfg. Co., covers three 150 h. p. water tube boilers with down draft furnaces, the Paul system of steam heating, two 300 h. p. Hoppes feed water heaters, boiler feed, house and air pumps, and the complete system of pipe work. One hundred and twenty-five pounds pressure will be carried.

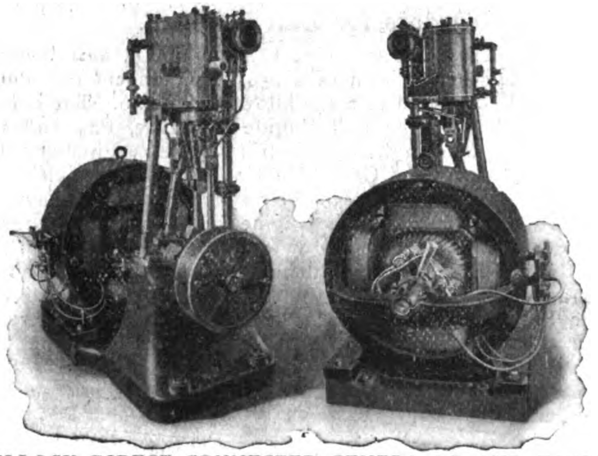
The General Electric Co. secured the contract for electrical equipment, covering three compound Imperial engines of 120 h. p. each, direct connected to three 75 kilowatt direct connected dynamos, speeded 260. There will be about 600 16 candle power incandescent lamps in the building, and 200 long burning enclosed arc lamps. The electrical plant will also furnish current for driving the entire elevator plant, the contract for which has been awarded to the Sprague Electric Company, of New York. This contract covers two passenger elevators, six freight elevators, one dumb-waiter and one ash-hoist. The distribution will be on the 220-volt two wire system for all the different kinds of service. The elevators are to be run from the same generator units as the lighting system. This installation represents a distinct advance in St. Louis in modern installations of this character, and its performance will be watched with interest. Messrs. Eames & Young are the architects. They have associated Messrs. Bryan & Humphrey with them as consulting engineers.

THE RAPID INCREASE in the number of indepenendent telephone exchanges has made the telephone supply business a very important item in the business of all of the electrical supply companies. One of the items used by the telephone companies for which there has been quite a large demand is that of rubber-covered telephone cables. The Paranite telephone cables which are being sold in the West by the Electric Appliance Company are securing a very high reputation among telephone people. The Electric Appliance Company are in a position to make most prompt delivery on these telephone cables for the reason that they represent the only rubber-covered wire factory located in the West. The Electric Appliance Company are enabled to ship any ordinary order for special telephone cables from their Indiana factory within a very few days after its receipt. The company are always pleased to submit samples at any time of what they are producing in this line.

CATALOGUES.

Bullock Bulletin on Direct Connected Generators.

THE Bullock Electric Mfg. Co. have just issued a new bulletin on their engine type of direct connected generators. The bulletin follows in general design their former bulletins,



BULLOCK DIRECT CONNECTED GENERATOR AND FORBES ENGINE.

consisting of eight pages devoted to handsome illustrations and short description. Their direct connected generator appears on the front page. The general design of this machine is similar to that of their standard multipolar machines, in that it consists of a circular yoke carrying inwardly projecting pole pieces of laminated soft steel of the highest magnetic permeability. The pole pieces are cast welded into the frame, thus forming a more substantial joint, both mechanically and magnetically. This generator is built in six standard sizes ranging from 25 to 200 kilowatts.

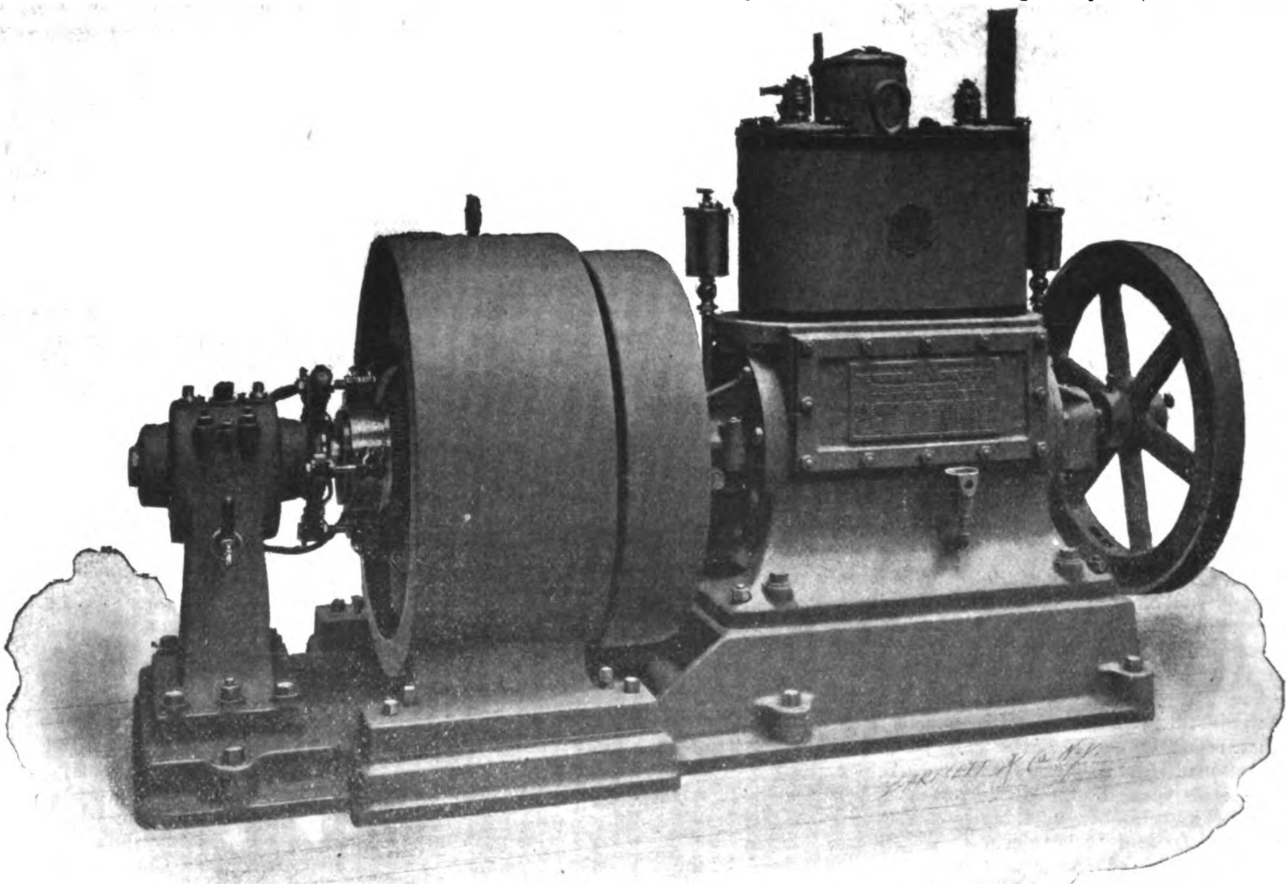
These generators are compounded to compensate for a drop of potential in the line. The shunt and series coils are wound on separate forms, and are removable at will. The field coils are so wound that they are open for the circulation of air, and perfect ventilation assured. All the compound coils are wound with bare copper, which is carefully insulated, and makes it practically impossible to burn out. The laminated core is made up of thin laminated plates of soft, well annealed steel. The periphery of the armature is slotted, and the windings are held in position by means of retaining wedges of hard wood driven into the notches near the top of the slot, longitudinally with the armature. This is peculiar to the Bullock machines.

On the third page of this bulletin are illustrated two views of the Forbes engine and Bullock generator. Under the illustration is given a table showing the sizes of engines and their corresponding sizes in generators. Another attractive generating unit displayed in this bulletin is the Bullock generator and Westinghouse engine.

In the course of a month a new bulletin will be published on motors for machine tools and their machinery.

New Johns Catalogue.

The H. W. Johns Manufacturing Company has issued a new and revised edition of its "Electrical Materials" in the compact and attractive form which has become well known to its customers and the trade at large. While the size of the book remains the same, the introduction of much new matter has greatly increased the number of pages. More space than heretofore is devoted to Vulcabeston in its various forms; the company's business in repair parts requiring more detailed information concerning such stock pieces as commutator rings, controller and motor parts, bushings, field magnet spools, etc. These are listed, with sizes and descriptions accompanying the illustrations. Many additions have been made to the list of trolley line materials. Among the new devices are splicing sleeves and ears



BULLOCK'S DIRECT CONNECTED GENERATOR AND WESTINGHOUSE ENGINE.

for "Fig. 8" wire, the Hartford section insulator or "break," trolley wheels, the "All-Steel" trolley bracket arms, designs for third-rail insulators, etc. Several more pages than heretofore are devoted to the "H. W. J." electric car heaters and the Electrotherm heating pad. Reductions in prices are noticeable throughout.

The New Headquarters of the Edison Mfg. Co.

AT Broadway and Twenty-sixth street, New York City, the Edison Mfg. Co. have just opened superb headquarters for handling their large and varied line of product, in the handsome new St. James Building. They have entered upon occupancy of the entire corner store and basement, giving them a total floor space area of over 8,000 square feet. The store is of lofty pitch, bisected by massive gilt columns, and has been finished in oak, with Pompeiian red finish for the wall, and heavy red carpets for the floor. There are roomy show windows all around, and the front entrance is beautifully recessed from the street, with a graceful glass awning thrown over it and part of the sidewalk. Right above the awning is the magic autograph, "Thos. A. Edison," executed in large fac-simile on a dark background, shining out at night in miniature incandescent lamps. Nothing could be more attractive than the exterior; nothing more satisfactory than the interior, and this was evidently the opinion of the crowds which availed themselves of the housewarming invitation on Saturday night last, between the hours of 7 and 9, when Manager J. W. Gladstone, and Mr. W. E. Gilmore, from the Edison laboratory works, were on hand to welcome their friends and extend the courtesies of the occasion. Not only were the show windows full of choice apparatus, but there were shown in their first form many of Mr. Edison's inventions, such as his vote recorder, phonograph, etc. These were inspected by thousands of people, who also listened to the phonographs at work around the store with fine cylinders on them, or else inspected the Edison X-ray apparatus, the Edison projectoscope, the Edison electro-medical apparatus, the Edison cautery transformers, the Edison fan motors, old style and new, the Edison-Lalande batteries, and a host of other beautiful appliances.

At the rear of the store is an elegant suite of offices, finished in oak and frosted glass, for Mr. Gladstone and the clerical part of his staff, with every convenience for the swift dispatch of work. In the rear of the store is a freight elevator, and the basement affords excellent facilities for the receipt and shipment of goods. Mr. Edison and his company are to be congratulated on securing such an admirable store, in a location that has no superior in the city for the exhibition and sale of standard electrical apparatus of the nature made and handled by the concern.

WESTERN NOTES

THE WALKER COMPANY claims that its type "S" Solenoid Blow-out Controller is the most popular one the company has ever placed on the market. The controller departments of their factories are turning out very large numbers of the type "S" apparatus.

AMERICAN ELECTRIC TELEPHONE CO., of 171-3 South Canal street, Chicago, have secured a very large contract covering apparatus for a 3,000 instrument outfit for the Saginaw Valley Telephone Co., which is to put in an underground system at Saginaw, Flint, Bay City and West Bay City. This plant was selected after a very exhausive test of apparatus on the market, and after a committee had visited several large "independent" exchanges.

WESTERN ELECTRIC COMPANY has brought suit against the Millheim Telephone Company for infringement, in the U. S. Circuit Court at Pittsburg.

WESTERN ELECTRIC COMPANY has issued a very interesting and handsome catalogue on its fan motors. Some of the details contained in it are given in our Trade Notes this week.

WESTERN ELECTRIC COMPANY have recently made a number of shipments of interior conduit and fittings. They always keep on hand a large and complete stock of conduit to meet all demands.

NON-SPARKING BRUSHES. The constantly increasing demand for W. E. non-sparking brushes shows that there is a necessity for an article of this description. The most stubborn case of sparking at the brushes and commutator is conquered by the use of the W. E. non-sparking brush, and it is highly recommended by many of the best dealers in the country.

SWINGING TREE INSULATORS. There has been some criticism by several men living north of Chicago in regard to the Western Electric Company advertising a swinging tree insulator when the snow was on the ground. But the circulation of the electrical trade journals extends from the most southern point of the civilized world to the most northern, and now is the time of year for at least 50 per cent. of the central stations in the United States to look after their outside lines and prevent them from coming in contact with the trees.

NAGLE & BALL, of Chicago, have been engaged as the electrical engineers of the Grand Rapids Board of Public Works, for the purchase or construction of an electric light plant. They are to receive $5,000, for all services, including plans and specifications, inspection and supervision. The firm is composed of A. F. Nagle and W. D. Ball.

DAWSON CITY, N. W. TY. The American Telephone Co., of Chicago, have just expressed to Seattle, a 100-number "Express" style switchboard, complete, with 100 telephones, to be used by a company at famous Dawson City, center of the gold rush. This apparatus is all packed in very narrow boxes, so that it can be placed on sleds and carried over the passes quickly and successfully.

WESTERN ELECTRIC CO. has recently opened a branch office in the Security Building, St. Louis, in charge of Mr. Irvine S. Jackson, who will devote his entire attention to the business in that city and the surrounding territory. This office will be furnished with every convenience for meeting the large requirements of the trade, both as regard prompt delivery of goods and satisfactory prices.

NEW ENGLAND NOTES

C & C. The location of the Boston office of the C & C Electric Company, of New York, has been transferred from the old quarters at 63 Oliver street, to more modern and commodious quarters at 19 High street, corner of Federal. The company's customers will be welcomed at the new offices by Mr. Wm. F. Palmer, who has recently succeeded Mr. H. A. Howard as manager for the company for New England.

MR. S. B. CONDIT, of the firm of L. A. Chase & Company, Boston, visited the New York market this week.

NEW YORK NOTES.

LUNDELL HORSELESS MOTORS. The Sprague Electric Company are meeting with considerable success in placing their Lundell Horseless Carriage Motor on the market. Quite a number are in use in this country, and very many abroad, particularly in England. In London, the Lundell Motor Equipment has recently been placed upon the mail van service, and excellent results are reported. Since the vans have been so equipped, it is stated that none have ever been behind time—a record which no other vehicle ever succeeded in obtaining.

SPRAGUE ELECTRIC CO. announce that the advance sales for their Lundell fan motors are greater than in any previous season. Doubtless their handsome new catalogue will serve to increase orders, as a great variety of handsome designs is therein displayed to great advantage.

McCARTHY BROS. & FORD have been appointed agents for the Sprague Electric Company for Buffalo, N. Y. The headquarters of the house are in the fine new Caxton Building in that city. Other appointed agents are Morton, Reed & Company, for Baltimore, Md.; Walker & Kepler, for Philadelphia; and Pettingell-Andrews Company, for Boston.

WALKER COMPANY has recently secured a very handsome and commodious suite of offices on the sixteenth floor of the Commercial Cable Building, 18-20 Broad street, New York. The suite includes a private hall, general offices, private offices for the officials of the company and all the latest conveniences for the modern transaction of business.

ADVERTISERS' HINTS

THE WALKER COMPANY, Cleveland, O., are calling attention to the several styles of electric locomotives they build for all classes of service, including mining locomotives for surface or tunnel haulage. Their New York office is now at 20 Broad street.

THE WESTINGHOUSE MACHINE CO., Pittsburg, Pa., have increased their facilities for the manufacture of gas engines and are beginning to get the better of their orders now. Some sizes are in stock for prompt delivery.

THE PRATT & WHITNEY CO., Hartford, Conn., advertise vertical and horizontal adjustable multi-spindle drilling machines in nine sizes and a full line of machinery for manufacturing bicycles, guns and sewing machines.

THE CROSBY STEAM GAGE AND VALVE CO., Boston, Mass., are well prepared to ship without delay all orders for valves for low or high pressures, and steam engine indicators, gage testers, vacuum gages, single bell chime whistles, feed water regulators, lubricators, etc.

THE ELECTRIC LAUNCH CO., Morris Heights, New York City, advocate the use of electric passenger boats as a paying investment at street railway parks and pleasure resorts. They stimulate traffic.

WHEELER REFLECTOR CO., Boston, Mass., state that they have made a careful study of abstruse problems in reflector lighting of all kinds and can now prescribe the special style of reflector to suit each particular case.

THE WESTINGHOUSE ELECTRIC AND MFG. CO., Pittsburg, Pa., advertise Wurts' lightning arresters for alternating and direct current circuits.

THE ELECTRICAL EXCHANGE, 166-174 South Clinton street, Chicago, are now the agents for the Standard Thermometer and Electric Co., the manufacturers of the famous Upton "Midget" enclosed arc lamps.

THE HOPPES MFG. CO., Springfield, Ohio, guarantee their live steam purifier to keep boilers clean and free from scale. Their new catalogue may be obtained for the asking.

EDWARDS & CO., 144th street, New York, are advertising electro-mechanical vibrating or single stroke gongs for exposed places, to operate on electric light or battery circuits.

HUGO REISINGER, 11 Broadway, New York, reiterates the warning to those who infringe his rights in using the "Electra" trade-mark on inferior brands of carbons.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., say that all the trouble incidental to short circuits can be avoided by the use of "Paranite" insulated wire.

THE BERLIN IRON BRIDGE CO., East Berlin, Conn., offer an iron roof for sale at a bargain. Owing to business reverses of the original purchaser the terms at which it is offered make it a bargain worthy of consideration.

THE PACIFIC ELECTRIC CO., La Crosse, Wis., have just brought out three new things, "Karsline," "Inline" and "Playtone," which they say are needed by every electrician. They will tell exactly what they are, their price, etc., on request.

RILEY BROS., 16 Beekman street, New York, are selling stereopticon slides illustrative of the most recent happenings, such as the Maine disaster, the Cuban war, etc. The plain slides are sold at 40 cents each, and the supercolored at $1.00.

THE GENERAL ELECTRIC CO. advertise alternating current enclosed arc lamps and mention in detail some of their numerous advantages.

THE SAFETY THIRD-RAIL ELECTRIC CO., Temple Court Building, New York, are introducing a third-rail system, of which a model is on exhibition at their offices. The system is fully described on another page of this issue.

MACHADO & ROLLER, 203 Broadway, New York, advertise "A. E. G." incandescent lamps.

C. S. KNOWLES, 7 Arch street, Boston, Mass., is carrying a full line of "Imperial" transmission insulators as well as his replete stock of supplies.

VITRO CHROME CHEMICAL CO., 42 Milwaukee street, Milwaukee, Wis., offer "Vitro Chrome," an indestructible incandescent lamp color, which they claim to be equal to natural glass in appearance and durability for inside and outside decoration.

THE CUTLER-HAMMER MFG. CO., Chicago, state that there are now over 10,000 of their high-class rheostats in use. The number constantly grows.

THE GARVIN MACHINE CO., Spring and Varick streets, New York, call attention to a screw machine that will make duplicate parts and pieces in a manner that will surprise the user. They have a complete stock of metal-working machinery ready for delivery.

THE EDISON MFG. CO., Broadway and Twenty-sixth street, New York, are ready with their 1898 models of battery fans and outfits. They are designed to run 150 hours on one charge of battery.

THE COLUMBIA INCANDESCENT LAMP COMPANY, Olive street, St. Louis, Mo., request that a test be made of the "Columbia" before annual lamp contracts are renewed.

THE C & C ELECTRIC CO., 143 Liberty street, New York, say that every detail of their machines is carefully worked out and perfected.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

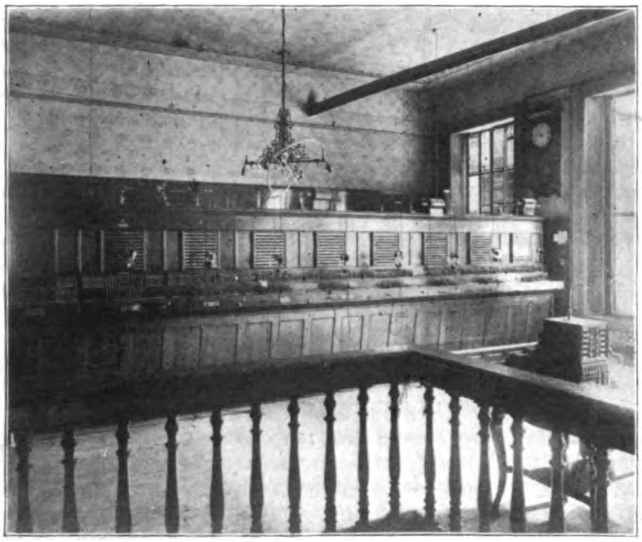
Vol. XXV. APRIL 14, 1898. No. 519.

TELEPHONY AND TELEGRAPHY

The Independent Telephone Exchange at La Crosse, Wis.

BY J. R. CRAVATH.

THE independent telephone business is by far the most active branch of electrical industry in the United States to-day. It is now in the active construction period that corresponds to the electric railway in 1890. New capital is constantly going into the business, new exchanges are being established, those already established are being extended, and in all quarters the independent movement is gaining strength. That some costly mistakes have been made, just as in the beginning of other branches of electrical work, must be admitted, but in the great majority of cases the investments in independent exchanges have proved to be wise, and the sympathy and support of the telephone using public has been with the movement.

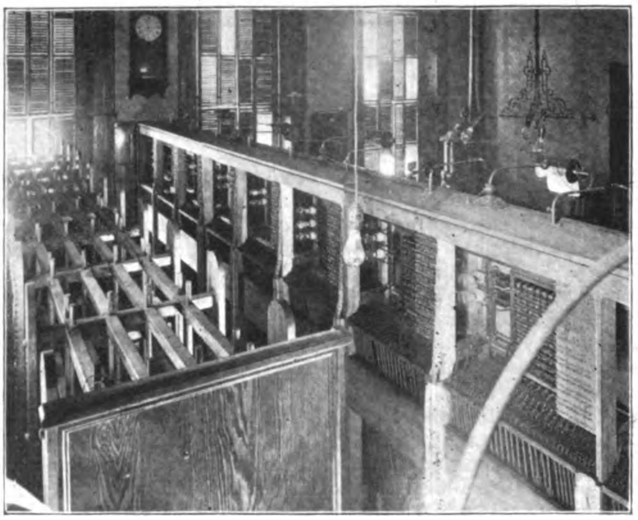


LA CROSSE TELEPHONE EXCHANGE; FRONT VIEW OF SWITCHBOARD.

The number of first-class paying independent exchanges scattered over the country is proof of the possible success awaiting enterprises of this kind. The La Crosse Telephone Co., of La Crosse, Wis., is one of these, and as it presents some interesting features from both a technical and an investment standpoint, it is worthy of an extended description.

La Crosse is a prosperous city of about 30,000 inhabitants. The exchange now has nearly 700 subscribers, and this is constantly on the increase. The Bell exchange has about half that number, many of whom are getting free service. The La Crosse Telephone Co. is composed of La Crosse business men, and has the following officers: Capt. I. H. Moulton, president; W. W. Cargill, vice-president; William Lohmiller, secretary and treasurer. Geo. R. Johnston, formerly of the Western Telephone Construction Co., who installed the exchange for that company, is now superintendent. Although chartered for several years, it was not until Oct. 1, 1895, that the exchange was put in operation. The rates (which have never been altered or cut since the exchange started), are $2.50 per month for business houses, and $1.50 for residences.

The accompanying engravings show the front and back of the exchange switchboard, which is divided into nine sections, one of which is for toll lines (at the extreme right) and one of which is left blank for future growth. This board is the product of the Western Telephone Construction Company, and is what may be called a multiple plug, in distinction to a multiple jack switchboard. It is well known that the complication and expense of a multiple jack switchboard as commonly employed in old line exchanges is something tremendous, though it has, up to within the last few years, been considered a necessity. It is interesting therefore to examine carefully anything that offers a simpler method of handling the business of a large exchange. The switchboard is wired for a complete metallic circuit throughout. In front of each operator is a panel of annunciator drops connected with 100 subscribers. These drops are a combination drop and spring jack. Thus when a subscriber rings, a shutter falls in front of the jack. The operator in inserting the plug in the jack to answer the call, restores the shutter by the insertion. The drop is thus made mechanically restoring rather than electrically restoring; and the wiring is simplified not only by the absence of electrical restoring wires but by the combination of the annunciator and spring jacks in one device. The subscriber's wires are connected only to the corresponding annunciator jacks on one section of the board instead of to all the sections as in a multiple jack board. Each operator can of course reach one section on each side of her. The connections out of her reach are made by an operator as follows: Directly in front of her is a set of plugs which are to be used for making connections with calling subscribers and also a set for connecting with called subscribers, as on all boards. Now, in multiple with these latter plugs are connected transfer plugs located at the right and left hand of every third operator along the board. Thus, suppose a board has seven sections for seven operators designated from right to left as at La Crosse, A, B, C, D, E, F, G. The cord circuits of certain plugs on A section will be connected with transfer plugs on sections D and G. There are also push buttons with which the A operator and D and G operator can converse, and so on; each operator is in communication with enough operators so that every number on the board can be reached. Supposing that A operator receives a call from a subscriber who wants a number on section C out of her reach, for example 354. A operator calls D operator, who can reach C, and tells her to connect a certain transfer plug (the other end of which plug is already connected to the calling subscriber on section A), to number 354. As soon as D operator does this, operator A rings for 354 just as if the called subscriber were on her own section, because the cord circuits on her section are in multiple with the transfer plugs on the other sections. The transfer plugs are of course never touched by an operator until she is told to use them by the operator to whose section they belong. When the conversation is ended and the subscribers ring off, the clearing out drop in the cord circuit connecting the two subscribers falls, showing the operator on section A that



LA CROSSE TELEPHONE EXCHANGE; REAR VIEW OF SWITCHBOARD.

the conversation is ended. She disconnects, but the plug is still in number 354, section C, and to notify operator C that she must disconnect 354, the following arrangement is devised: The sockets into which the plugs fall when not in use are wired with an incandescent lamp circuit which is closed only under

these conditions, namely, when an answering plug is out and a transfer plug is in a jack. So when A operator, in the case under consideration is notified by the clearing out drop to disconnect, the plug is pulled out and let fall back into its socket. This closes the lamp circuit and lights two lamps, one on section D, notifying that operator to disconnect, the other on section A, telling that operator as long as the operator at D has failed to disconnect. For this purpose two 26 volt lamps are used in series supplied from 110 volt lighting mains and connected in series with a resistance to reduce the voltage. These lamps both go out as soon as both operators disconnect.

The chief operator's board has a lamp for every section of the main board. Each lamp is so connected that it is lit whenever an annunciator drop is down on a section. It might be thought that these lamps would be lit all the time, but such is not the case, for the operators, aware of this tell-tale, make very quick work of answering a drop. The chief operator can bridge in her telephone and transmitter on any operator's circuit either for conversation or listening to learn what is going on.

Transmitters in the exchange are supplied by gravity batteries. The ringing is done with a ½-horse-power Crocker-Wheeler motor generator giving 60 volts alternating on its secondary and run from a 110 volt circuit.

A metallic circuit with common return is used for all instruments connected to this exchange. The common return wire is No. 6 copper, and the individual subscriber's wires are iron.

The force usually employed consists of 12 operators, 2 linemen, 2 men on general work, and 1 manager.

Practical Features of Telephone Work.—V.

BY A. E. DOBBS.

IN regard to the size of the return wire, there is a wide diversity of practice even among the various Bell companies, who have perhaps greater uniformity of engineering practice than is possible among independent companies. In some places a No. 4 wire has been run out to serve 500 subscribers; in others, No. 0 is used for half that number. Some ground the wire at the office and various other places; some only at the office, which is better. Some don't put on any ground at all, better still; while others do not even bring the wire into the office at all, cutting it off at the pole outside and letting the talk come in over the other lines, which is not a very good way, though there may be circumstances that justify it.

One company puts its subscribers in groups of from 20 to 40, using a No. 10 wire for each group.[1]

An acquaintance, unable to determine the question for himself, took a trip to a distant city to consult an eminent electrical engineer on the matter, and as a result of his advice strung six No. 6 copper wires to return the back talk of about 250 sub-

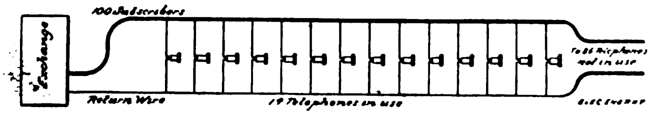


FIG. 14.

scribers; a clear case of wasted copper, for one of these wires would have answered just as well. And the worst of it was that there was more cross talk in that exchange than in any other modern exchange I have ever seen, and he cannot be convinced to this day that the cross talk does not come from an insufficient amount of copper. Had he studied more about cable and switchboard work he would have had better success.

By the way, his city friend was a man who ranks high in his profession, but he has spent all his life designing motors and superintending street railway installations, and can hardly be regarded as a telephone expert, even though he does frequently "get his name in the papers."

There is an impression among the new men in telephone work that a bulky return wire is necessary and if there is any cross talk the wire, already larger than necessary, is reinforced, and —the cross talk is still with them.

The fault will generally be found in the switchboard or cables, and a return the size of a trolley feeder would not help matters. But more of this later.

Before going further let us do a little work in simple arithmetic. Let us take, for example, a lead of 100 subscribers and try to get at the resistance of the return:

The resistance of the drop, say	150 ohms
Resistance of bells	80 ohms
Resistance of average line, including capacity, etc.	70 ohms
Total	300 ohms

This may be put down as the lowest average resistance of a line when not in use. Of course the resistance of drop and bells will vary over wide limits.

Of the 100 subscribers the occasions will be rare when more than six pairs of plugs (12 subscribers) are in use, but let us say seven pairs (or 14 subscribers).

On the lines in use we have:

Two induction coils of 250 ohms each	500 ohms
One ring off drop	100 ohms
Two receivers	150 ohms
Line resistances, etc.	100 ohms
Total	850 ohms

One coil however by its self induction throws back on the line almost as much current as it receives, but the self induction of the other coil will raise its resistance, in almost the same ratio so that 500 ohms for the two coils is not far out of the way.

As will be seen by reference to Fig. 14, the subscribers on a common return system—or a grounded system for that matter—are all connected in multiple.

We have shown fourteen telephones connected to the exchange

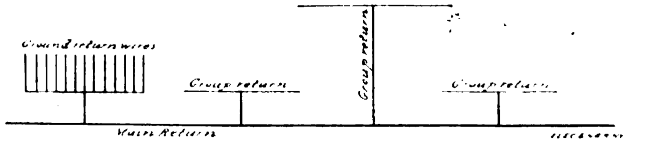


FIG. 15.

in actual use, the lead of 100 subscribers being for convenience's sake, represented in the form of a cable.

It will be seen that the current will not only come in on the return wire, but will distribute itself to every other wire in the system in proportion to its resistance. Now let us see:

Total return resistance of 14 lines in use $= 850 \div 14 = 67$ ohms

Total return resistance, 86 lines not in use $= 300 \div 86 = 3.5$ ohms

Now, if the average subscriber's distance from the central office be three-quarters of a mile, a return wire that will balance the resistance of the 86 lines not in use should help us out all right.

By looking over a table of resistances for copper wire we find that No. 9 B. & S. has a resistance of a trifle over 4 ohms to the mile, therefore the resistance of three-fourths of a mile of this size would more than balance the conductivity of the lines.

Our return now therefore would be:

86 lines	3.5	ohms
Common return	3	ohms
Combined return and 86 lines	1.6 +	ohms

From this we will see that the relative conductivity of these 86 lines, and the common return, is 1.6 to 67 ohms, a proportion of 42 to 1.

The one part left for these 14 wires is divided up among the 13 other wires, or in other words, the 14 lines, if their resistance is approximately the same, receive $\frac{1}{42 \times 14}$ or $\frac{1}{588}$ of the current.

We can therefore lay down the following rule for getting at the size of the common return:

1. Find the resistance of one line for the average distance from the exchange, including that of the drop and bell magnets.

2. Subtract from the total number of lines, the number of lines which may be in use at one time. (14 in 100 is a good number.)

3. Divide the resistance of one line by the number of lines so left, and select a wire, whose resistance to the centre of distribution will be equal to this quotient.

[1] As copper is nearly always sold by the Brown & Sharp gauge all copper wire will be given in this size; also, iron wire is generally sold by the English standard or Birmingham gauge (B. W. G.). The B. & S. gauge runs about two sizes larger for the same size of wire. Thus No. 10 copper is about the same size as No. 12 iron, while No. 12 copper matches No. 14 iron, etc.

In order to have reliable service it is not generally advisable to use a copper wire smaller than No. 10 B. & S., except on leads having not more than 25 wires.

When wires on different leads are joined together, the wire towards the office end should be increased in proportion unless it is already sufficient to do the work, and when they are all joined together at the office pole a wire equal in cross section to all of them, brought to the switchboard or bus-bar.

In places where electric light and power induction is unusually severe, it may be necessary to divide the subscribers into groups of from 20 to 40 lines each, keeping the subscribers in each group as close together as possible, carrying the return from each group back to the office.

Where this is the case and two or more return wires run on the same pole, they should be kept as close together as possible and frequently transposed, or—this is merely an hypothesis of the writer—it might be well to run out one wire large enough to supply all the subscribers and have the return wire for the different groups kept separate, and connected to the main-return on much the same principle as the feeder and main system in electric light wiring, Fig. 15, in which the main return wire should be heavy enough to leave but a small resistance between the different groups.

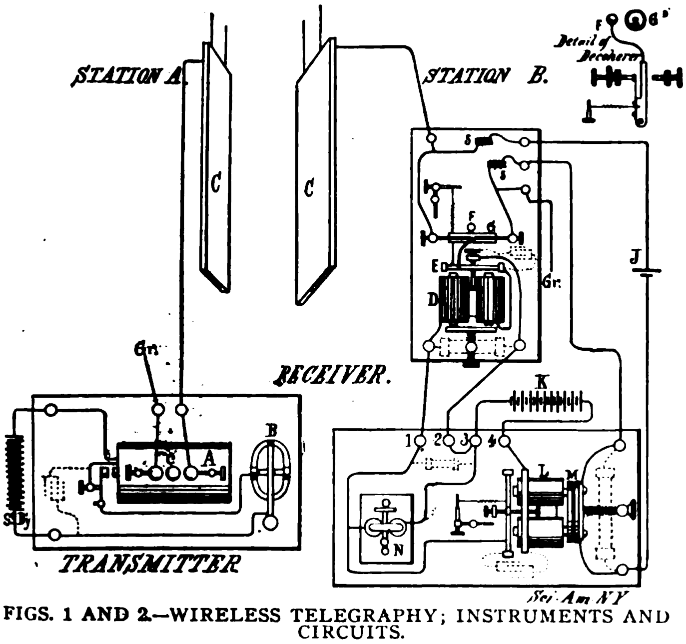
In some exchanges it is customary to ground the common return wire at the office, but I think that a better balance is preserved by not grounding. Still there are places where it is very inconvenient to run two wires, and being able to run a ground is quite an advantage.

In making house connections use porcelain knobs instead of brackets, for brackets on the side of a house are always unsightly, and well glazed porcelain affords insulation enough for all practical purposes, but do not cover the side of the house with them, for two or three are nearly always enough.

While on this subject we may as well say that wires from the pole to the house should ont be drawn very tightly, as it is not often necessary, and a tight side wire will not only pull the pole out of line, but is apt to be a "hummer."

Clarke's Apparatus for Wireless Telegraphy.

ON March 25, Mr. W. J. Clarke gave a practical demonstration in this city before the New York Electrical Society, of the Marconi system of wireless telegraphy, which proved highly successful. Mr. Clarke made use of his own apparatus, which have been perfected after months of experimenting. The apparatus illustrated below embody the latest improvements



FIGS. 1 AND 2.—WIRELESS TELEGRAPHY; INSTRUMENTS AND CIRCUITS.

based on recent investigations, and are commercially suitable to the requirements of wireless telegraphy in this country. Mr. Clarke showed the apparatus illustrated in Figs. 5 and 6 and diagrams, Figs. 1, 2 and 4, by reference to which it will be seen that both the transmitting and receiving stations are shown in Figs. 1 and 2, station A being the transmitting and stations B and C the receiving. The transmitter shown at station A gives the most efficient kind of spark for the purpose. The coil is fitted with an ordinary vibrating make and break, constructed so as to give just the requisite number of interruptions. A special Morse key, B, is placed in the primary circuit, and the condenser is so connected as to kill the spark at the key contact as well as at the vibrating contact. Mounted on the upper part of the coils are three solid brass balls, C, the centre one being stationary, and the outside ones adjustable, so that their

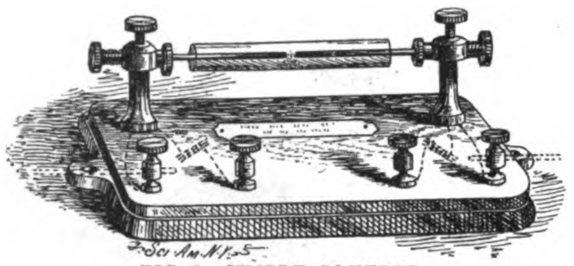


FIG. 3.—SIMPLE COHERER.

distance from the centre ball can be regulated at will. The two outside balls are connected to the terminals of the secondary coil, as are also the binding posts shown at the side of the coil. It will now be readily seen that when the key, B, is depressed, sparks will pass between the balls, and will immediately cease when the key is released. By means of the two binding posts at the side of the coil, one terminal of the secondary coil is connected to earth, and the other terminal to the large metallic plate, C, which should be placed high in the air. The coil may be operated by any suitable battery, but a small storage battery is very much to be preferred.

The receiver at station B consists of two separate instruments, the Clarke coherer relay being mounted on one base, and the

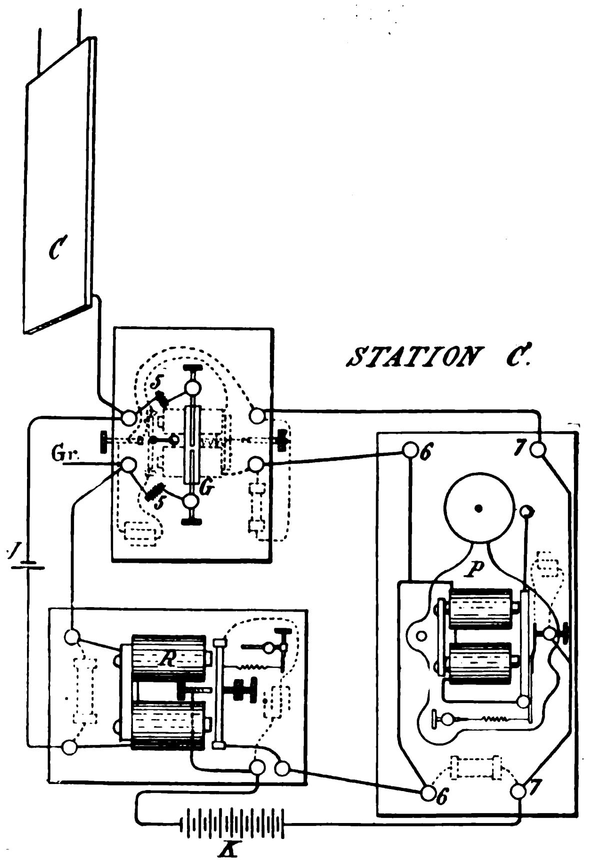


FIG. 4.—WIRELESS TELEGRAPHY; APPARATUS FOR BELL SIGNALS.

polarized receiving relay and sounder upon another. The coherer, G, is a small glass tube made of selected glass, and carefully fitted with two metallic plugs, whose distance from each other in the tube can be readily and accurately adjusted by means of the screw and spring adjustments shown at each end of the tube, Fig. 3. The space in the tube between the plugs is partly filled with specially prepared metallic powder, and the

two plugs are connected to the binding posts shown, through the small choking coils, 5. These posts are connected to the magnets, L, of the receiving relay through the main battery, J, and binding posts of polarized receiving relay as shown.

One terminal plug of the coherer, G, is connected to earth as shown, and the other terminal plug is connected to the large metallic plate, C, which like the plate at the transmitting station should be placed high in the air. When the powder between the plugs in the tube is lying in its normal condition its resistance is extremely high, often reaching 20,000 ohms, but when the key of the transmitter at the distant station is depressed, electric waves are sent out into space; these waves travel from the plate, C, of the transmitter to the plate, C, of the receiver, and finally reach the powder in the tube, G. Under the action of the waves, the particles of powder in the tube immediately cohere, and their resistance instantly drops down to between 7 and 25 ohms, which great decrease in resistance permits the current from the battery, J, to pass through the circuit, and energize the magnets, L, of the polarized receiving relay, which in turn operates the sounder, N, using the large local battery K. When the powder in the tube once coheres, it remains in that state until the tube receives a sharp tap, when operates the vibrating hammer as shown, which it will be seen will keep constantly tapping the tube as long as the key at the distant station is depressed, the powder refusing to decohere as long as the waves are passing through it; but the moment that the key at the transmitting station is released, the last tap of the vibrating hammer, F, decoheres the powder, and thus practically opens the circuit of the battery, J. In order that the apparatus may work properly, it is necessary that every part of it be very carefully constructed, and a wide range of adjustments provided; this last is especially true of the decohering apparatus, which must be so arranged that the vibrating hammer can be adjusted to strike the tube with just the necessary strength of blow. It is also found necessary to have all the magnets wound to a very high resistance, and their terminals provided with resistance coils of still higher resistance; and as the sparks produced by the contacts of the polarized receiving relay, and also by the vibrating contacts of the decohering apparatus, send out waves which affect the coherer, these sparks must be almost entirely suppressed by the use of suitable condensers in the bases of the instruments. This set of apparatus is used for the transmission of Morse signals to moderate distances only, but for longer distances it is simply necessary to use a much larger and properly designed induction coil in connection with the transmitter.

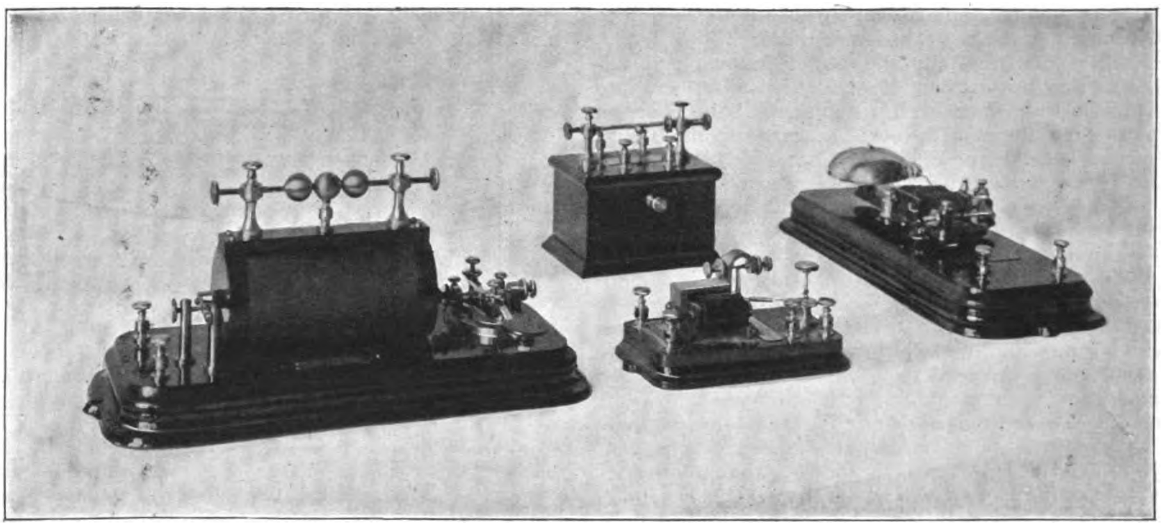


FIG. 5.—INSTRUMENTS FOR TRANSMITTING ELECTRIC SIGNALS BY MEANS OF WIRELESS TELEGRAPHY.

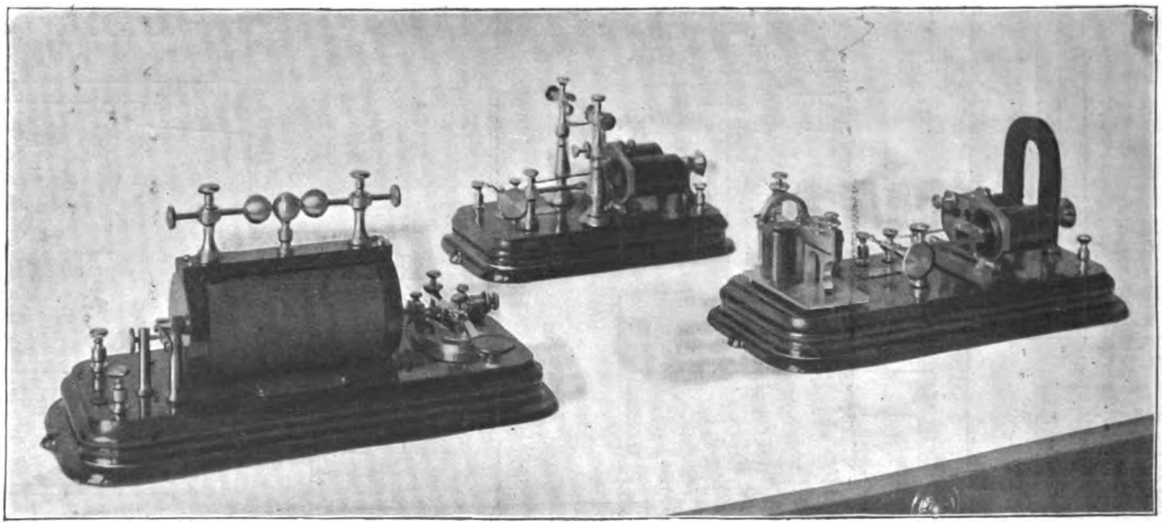


FIG. 6.—INSTRUMENTS FOR TRANSMITTING MORSE SIGNALS BY MEANS OF WIRELESS TELEGRAPHY.

the powder instantly de-coheres and its resistance rises again to an extremely high point. In order that Morse signals can be transmitted it is necessary, of course, that the tap on the tube be automatically accomplished. In order to secure this the decohering magnets, D, are provided and placed in multiple with the magnets of the sounder, so that the magnets and decohering apparatus will operate simultaneously; the decohering magnet

It is frequently desirable to dispense entirely with Morse signals, and this is especially true on shipboard or in places where there is much noise and where a much louder signal or a visual signal is required. To meet these requirements a much less expensive set of apparatus has been designed. The transmitter is

precisely the same as in the preceding case, but the polarized receiving relay, R, is much smaller and is not provided with as sensitive adjustments, it having been found that for bell signals they are not necessary. The sounder is entirely dispensed with, and is replaced by a high class vibrating bell, shown at P in the diagram of receiving station C, shown in Fig. 4. The bell is so arranged that it can be adjusted to work in unison with the vibrations of the decohering apparatus. The Clarke coherer relay in this case is mounted on top of a mahogany box which contains the decohering magnets, resistance coils for bridging the terminals and also condenser for suppressing the spark at the vibrating contact, as fully shown in the diagram at station C. The plugs in the cohering tube, G, are provided with the same adjustment as in the more elaborate set. The working of the apparatus is perfect in every respect. When required, the vibrating bell, P, can be replaced by an incandescent lamp which can be readily turned on and off from the distant station. It is certainly extremely interesting to place the transmitter of this set in one room and the receiver in another and then listen to the vibrating bell ring out loudly in response to every impulse of the waves. No ground connection, however, or air plate is required for either set of apparatus when the distance between the transmitter and the receiver is comparatively short. For the benefit of those who wish to experiment, and perhaps endeavor to build their own apparatus, a simple coherer is provided which is shown in perspective in one of our half-tone illustrations and in detail in the lower engraving. The outer binding posts of this coherer are intended to hold two light rods of metal of equal length in projecting out on either side. These rods or wings are necessary when it is desired to transmit to any considerable distance without using the earth connection or air plate. We are indebted to the "Scientific American" for illustrations.

ELECTRIC LIGHTING

Statistics on English Electric Lighting Plants.—I.

BY CLAUD P. D'OYLY.

FOR some years past the electrical papers have contained accounts of the new stations going up at different times in various European cities and have presented beautiful photographs showing pressed brick stations, underground conduits and transformer stations with glazed tile interiors. We have heard of and seen the concentric cables and the ornamental steel arc lamp poles and we have admired and have sometimes wished that we had the time, not to mention the money, to put in such elaborate work.

There are in England, Scotland and Ireland at the present time about 134 commercial and municipal electric lighting companies. About two-thirds of these use the alternating current and one-third direct current and storage batteries. About one-half of the plants are owned by the municipal authorities, as they are able to borrow money at a very low rate and are frequently willing to operate the plant at a loss for a few years. The public generally favor the idea that the four principal items affecting the general comforts of the taxpayers, viz., water supply, artificial lighting, drainage and highways, should be under immediate control of the local authorities.

Owing to the low price of labor they have not paid as much attention to coal and ash handling machinery as we have, but in other directions their money and energy have been expended prodigally to make work which shall be permanent and shall show small deterioration. I shall attempt in these few brief articles to show some of the effects of this expenditure on the operating expenses and net and gross earnings as far as they are comparable with results we have in this country. I have taken as examples stations of moderate output in smaller towns, of which Pontypool, with a population of 5,800, is the smallest, and Birmingham is the largest. The London stations do not give any data which can be compared with that of any similar stations in any other part of the world, unless it be New York; and here the interest required for money and the cost of labor change the conditions very much, so that really there is no comparison possible.

In considering plants in England, it must be remembered that at present the country is "money poor," that is to say, trustees and others having money to invest have the utmost difficulty in securing investment which will net 2½ per cent. per annum, and which investments will run without being disturbed or paid off, a reasonable length of time. British government bonds, which pay 2¾ per cent., and which in a few years will only yield 2½ per cent., are selling at 112, and any of the municipalities can borrow money at 3 per cent., usually from local investors, without any trouble about paying commissions to bankers and without advertising. The conditions of demand are very stable; they do not have new cities build up outside the present limit, necessitating doubling the voltage, additional stations, rotary transformers, etc. A plant can be laid out in the best method, and plans made for the very distant future; people do not offer inducements to manufacturers to move a plant with some thousand of employés into new neighborhoods, thus changing the whole nature of the locality. City councils do not grant franchises to new companies to occupy the territory already covered by a chartered lighting company; there are no State Legislatures to reduce the price received for the light in order to gain popularity; and the Board of Councilmen do not threaten to build a municipal electric plant every time the lighting contract comes up for renewal. There is not so much hostile feeling towards incorporated companies, and as long as the rates for current are being reduced and the service is being bettered, people are satisfied even if the stockholders are receiving 8 or 10 per cent. for their money. A very large number of the users of electric light are people of small incomes, who can use it for less money for a month than they can use gas, even at 65 cents per 1,000 feet. Many rich people who make no account of small expenditures still use the gas exclusively, chiefly because they object to tearing up the whole house for putting in the wires. All these people will be users of electric light later on.

One feature which rather attracts attention from an American engineer is the cheerful way in which in their report the boards of electric light companies refer to the loss from operation for the past year, without having had disastrous accidents or any cause for excessive outlay. They calmly congratulate stockholders on the improvement; the loss was reduced so much for the current year, etc.

In table 1 herewith will be found some figures on some plants which I took some time to look up. They show some of the results of operation, and which will prove of interest as demonstrating various financial results.

Kingston-on-Thames has an alternating plant which Mr. J. H Preece designed, using Siemens Bros.' apparatus. They have spent $112,500 up to the last return and have an income of $12,000; after allowing to the sinking fund $2,535, there is a loss of $6,900 for the year. In addition their report shows that their current cost to deliver 9.54 cents per k. w. h. and was sold for 8.36 cents, with a total of lamps installed of 5,384, each lamp 8 candle power.

Bristol, a city of 220,000 inhabitants, has expended $500,000 on a plant of about 1,300 h. p. and has 38,000 8 candle power lamps wired on the circuits. After allowing for depreciation for the year, $18,000, the result for the year was a financial loss of $25,000, but of this the interest is charged on the sum borrowed to put in the plant, and allowance is made for the sinking fund. The average price obtained was 10.62 cents per k. w. h. and the cost of same was 6.38 cents. This plant has been in operation two years. It serves on the city circuits 105 arc lamps, which should be credited against the net loss for the year. Newport, Monmouthshire, has an alternating station which has cost $172,000 and has 7,300 8 candle power lamps on the circuits; the revenue was $7,160 and the sinking fund allowance was $3.520; current was generated for 6.42 cents and was sold for 7.22 cents per k. w. h.; the net loss for the year was $7,000. Taunton, a Devonshire borough, of 18,000 inhabitants, takes pride in the fact that it is a pioneer in electric lighting among the smaller cities. It is the headquarters of Messrs. Newton & Company's manufacturing establishment, and shows a very capable and truly commercial spirit in its management and the results attained. There are about 7,200 8 candle power lamps wired on the circuits and 56 public arc lamps, and the plant shows a steady increase each year. There is $90,000 invested in the plant. The revenue for twelve months was $11,500, and after making the different charges, including $2,600 for depreciation, the net loss was $2,225. The price received for current averaged 9.78 cents, and the current cost to deliver 7.82 cents per k. w. h.

Bedford has an alternating plant capacity 420 k. w. and has 17,000 8 candle power lamps wired on the circuits. The cost of the plant has been up to date $293,000 or almost $700 per k. w. In the past year the cost per k. w. has been increased about 40 per cent., but it has been done in such a way as to increase the efficiency of the plant, so that where a year ago the current cost 6.56 cents to generate, it now costs something less than 5.76 cents per k. w. h. There is also being invested much money for increased mains and transformers and meters, and the lamps wired in on the circuit have been increased 4,000. Most of this capital expenditure, it is only fair to state, has not yet had a chance to be productive, but should show up well in the report for 1898.

Dover is another town with an alternating station of 325 k. w. capacity and railway generators of 200 k. w. capacity, which have cost in all $270 per k. w. The electric railway has only been in operation a very few months, but it shows that the cost per k. w. delivered will be materially reduced. In 1896 the cost per k. w. sold was 10.26 cents, and in 1897, with four months of electric railway operation, the cost per k. w. was 8.34 cents. The load required for the tramway was 12 per cent. of the total current generated. This might give a hint to some small towns where they are operating separately a small electric light and a small electric railway station, neither of which pays dividends.

Pontypool has a small plant, direct current, with storage batteries, and has 3,000 8 candle power lamps wired; the plant cost $33,000 and has a gross revenue of $4,600; after allowing $600 for depreciation the profit was $912; the current cost 8.96 cents per k. w. h. to generate and sold for 11.82 cents. The population of Pontypool is 5,800, and the plant started in with only 800 8 candle power lamps, but has grown continually and has paid dividends of 3 per cent. annually.

Brighton has a population of 116,000, and has a direct and alternating plant which has cost over $700,000. While the plant has not progressed with the vim of an American plant, there has been a very healthy growth, and the cost to the consumer of current has been reduced under the able management of Mr. Arthur Wright. The station has an output of 1,200 k. w. and has cost about $600 k. w., and is the property of the municipality. There are something like 70,000 lamps wired on the circuit, and the charges are 14 cents per k. w. h. for an average of one hour per lamp per day and 3 cents for all over that. That settles the expense where it belongs, on theatres, and churches, and shops, which only use current at the time of the peak of the load, and it reduces the price below that charged for gas, to householders. The revenue of the Brighton plant is about $90,000 per annum, but has been expanding at a great rate since the council reduced the rate from 6 cents to 3 cents after the first hour. The price received in Brighton for the current averages 9.41 cents per k. w. h. and the cost for generation and delivery of same is 4.72 cents. The operation of this plant would show a large profit under a Board of Directors, but under municipal control much that is clear profit is charged to depreciation, sinking fund, etc.

Bradford, the centre of the woolen manufacturing district, has a direct current plant, which has cost $356,000, of a capacity of 1,400 k. w., about $250 per k. w. The current is generated at a cost of 4.48 cents per k. w. h. and sold at a net price of 9.56 cents per k. w. h.; the lamps on the circuit amount to 38,500. Coal is very cheap at this point, which brings down the cost of manufacture. The highest point for cost of fuel of any of these enterprises was 3.24 cents per k. w. h. and the lowest 1.08 cents; but the conditions are so different as regards supply of coal that an analysis cannot be made, although the Brighton plant is one which is handicapped.

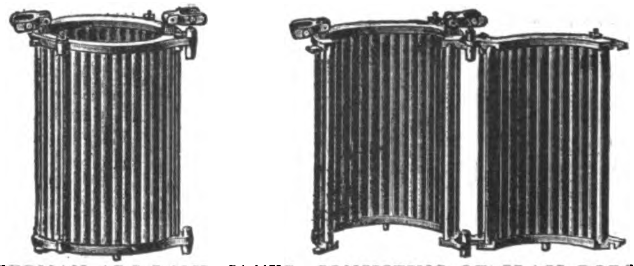
TABLE I.

Town.	System.	Capital to Revenue, to Last Return.	Depreciation and Last Return.	Sinking Fund.	Net Financial Result.	Price per Unit. Av. Price Obtained, Cents.	Cost per Unit, Cents.	No. of Lamps, 8 c.p.
Kingston-on-Thames	H. T. A.	$112,500	$12,035	$ 2,585	*$ 6,910	8.36	9.54	5,384
Bristol	H. T. A.	488,970	47,215	18,000	*25,455	10.62	6.38	25,791
Newport Mor	H. T. A.	172,810	7,245	3,535	*7,050	7.22	6.42	7,278
Taunton	H. T. A.	90,540	11,725	2,615	*2,225	9.78	7,82	5,000
Pontypool	L. T. C.	32,915	4,565	585	†595	11.82	8.96	3,238
Brighton	L. T. C.	761,120	87,700	21,175	†5,745	9.42	4.72	70,064
Bradford	L. T. C.	357,285	68,840	13,965	†13,900	9.56	4.48	38,500
Bedford	H. T. A.	293,000	23,590	7,800	*6,000	8.84	5.86	13,000
Dover	H. T. A.	250,000	26,200	......	*16,000	10.76	8.34	17,500

*Loss. †Profit.

German Arc Lamp Covers for Modifying the Intensity of the Light.

A unique arc lamp cover, which has already found a considerable market in this country, has been introduced and patented by the firm of Schmidt & Westerman, of Hanover, Germany. It is meant to replace and improve upon the use of the ground glass or opalescent globe and consists of cylindrically arranged glass rods as shown in the figures. These glass rods are held in place by two iron rings, which are



GERMAN ARC LAMP COVER, CONSISTING OF GLASS RODS, OPEN AND CLOSED.

grooved so as to receive the rods and are held together by means of wire rods fastened by nuts. The glass rods do not absorb as much light as the opalescent or frosted globes, but disperse and distribute ahe light very efficiently and eliminate all traces of shadow.

The cylinder, consisting of glass rods, can be easily opened, and, therefore, can be cleaned with ease. It may also be mentioned as a special advantage that in case of breakage the entire cover need not be thrown away, but single rods can be replaced. These covers can be fitted to any lamp and can be supplied with any type of reflector or locking device.

FAR ROCKAWAY, L. I. The Citizens' Electric Lighting Co. are to build a new electric lighting plant to supply Inwood, Rockaway Beach and Far Rockaway; also Lawrence, Cedarhurst, Woodsburgh and Hewletts.

HIGHLANDS OF NAVESINK, N. J.—The first order fixed white light at the Highlands, overlooking Sandy Hook, is to be replaced by an electric light showing a white flash of about one-tenth of a second duration every five seconds.

SEOUL, KOREA, is to have a company for electric light and traction, with a capital of $600,000. Mr. H. Collbran, of Denver, Col., has a contract for six miles of trolley construction on the Seoul-Chemulpo Railroad. The Seoul Electric Co. is composed entirely of Koreans, with the governor of the city as president.

MISCELLANEOUS.

Liquefied Air.

BY SOL. D. BENOLIEL, E.E., A.M.
Adelphi College, Brooklyn, N. Y.

THE commercial introduction of liquid air is due to the efforts of Mr. Charles Tripler, who claims to have succeeded in liquefying the atmosphere as far back as January, 1890, but who, until now, has withheld his valuable invention from the public. His compressor is an ordinary steam engine consisting of three cylinders placed in the same straight line, each one being operated by the same piston rod. The air is carried through three degrees of compression, reaching a pressure of 2,000 pounds to the square inch in the third cylinder. The cylinders are all water jacketed in order to remove the heat caused by the high pressures exerted upon the air. From this cylinder the air is allowed to escape partly through a long and very narrow tube of about one-thirty-second of an inch in diameter, and partly through a tube that surrounds it and which serves as a jacket, the whole apparatus being well insulated with a magnesia covering. The air in expanding from this pressure of 2,000 pounds down to atmospheric pressure, does work, and consequently loses heat, but not sufficient to cause the air to reach the critical temperature or that temperature above which no amount of pressure can liquefy it. It is a well-known fact that the more work an expanding gas has to do, provided no heat is communicated from without, the more will its temperature be reduced. Mr. Tripler has ingeniously taken advantage of this fact by the construction of a peculiar valve through which the air must pass after leaving the cylinder, and in doing so a great deal of its energy is used up, resulting in a great drop in the temperature of the air. It is particularly upon the construction of this valve that Mr. Tripler bases his invention. The air flowing through the outer tube or jacket is wasted, serving only to prevent communication of the heat to the inner tube. A short time after the engine has been started a continuous stream of liquid can be drawn with the expenditure of but 40 horse-power. That liquid air can be produced cheaply enough for commercial purposes is certain, since with the crude experimental apparatus in use, ten horse-power hours can produce about one gallon of liquid air. Mr. Tripler has in mind many improvements upon his apparatus which he will introduce in any new plant he may set up, and there is not the slightest doubt, that if the manufacture of liquid air be carried out on a large scale, its cost of production can be reduced to one-half.

Air has been previously liquefied, but the process was long and very expensive, and consisted in the successive employment of liquefied gases boiling at lower and lower points on the scale, the final cooling being affected by the rapid cooling of the product itself.

Within the last three or four years patents have been taken out by Dr. C. Linde in Germany, and Mr. W. Hampson in England. In both of these processes liquid air is produced without the aid of any intermediate refrigerating agents. Dr. Linde in 1895 succeeded in liquefying air with a pressure of 2,850 pounds only after a two hours' run. Mr. Hampson devised a piece of apparatus in 1896 in which he claims to have done much better. In both cases the quantities of the liquid air obtained were very small. In fact, it has been said that it is doubtful if either of these men ever saw a couple of gallons of this liquid air at any one time. Although both of these processes were great improvements over former methods, yet compared with Mr. Tripler's invention they cannot be considered as commercial.

The properties of liquid air and of its constituents as well as the effects of the exceedingly low temperatures upon the properties of materials have been partly investigated by Dewar, Wrobleosky, Olszewski, Pictet and Cailletet.

Liquid air is opalescent and has very much the appearance of a milky fluid. This is due to the suspended solid particles of carbonic acid gas which can be very easily filtered out. Its density is little less than that of water, being 0.93. It boils at the very low temperature of about — 310 deg. F., so that it is very difficult under ordinary conditions to prevent it from boiling. Prof. Dewar has devised a tube, shown in Fig. 3, to hold his liquid air, which was jacketed by a highly exhausted vacuum. He found that the liquid air placed in it would evaporate only one-tenth as fast as it would if placed in an unprotected vessel.

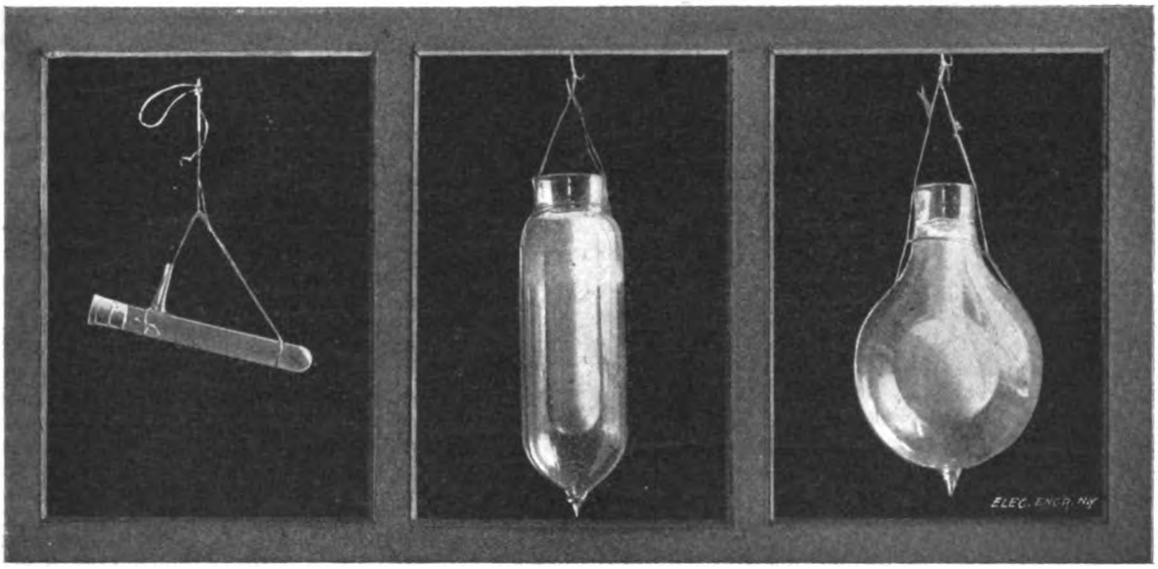


FIG. 1.—APPARATUS USED TO PROVE LIQUID OXYGEN MAGNETIC. FIG. 2.—PROF. PECKHAM'S VACUUM BULB. FIG. 3.—PROF. DEWAR'S VACUUM BULB.

Prof. Peckham has suggested the use of a different form, see Fig. 2, which has the advantage of being much easier and cheaper to manufacture. It also has the advantage that the surface from which the liquid evaporates is small and constant no matter to what level the liquid may be in the tube, whereas in Prof. Dewar's, the surface from which evaporation takes place is quite large when the bulb is not full.

The boiling point of liquid oxygen is — 299 deg. F., whereas liquid nitrogen boils at — 317 deg. F. When liquid air is allowed to stand, the nitrogen boils off faster than the oxygen, the result being that the air becomes continually richer in oxygen. Ordinarily air contains but 20 per cent. of oxygen, but by transferring the liquid air several times from one vessel into another and then upon filtering out the solid carbonic acid gas, a bluish liquid is obtained which is almost pure oxygen.

One of the most interesting and at the same time one of the most successful lectures given this year before the Brooklyn Institute of Arts and Sciences, was that by Prof. William C. Peckham on liquid air, at Adelphi College, Brooklyn, on Friday evening, March 25.

The experiments performed by Professor Peckham may be grouped under the following headings: 1. Excessive low temperature of liquid air and its utilization in freezing a number of substances having low freezing points. 2. Its great expansive power when enclosed. 3. Chemical action of the liquid oxygen upon different substances. 4. Effects of this very low temperature upon the properties of various materials.

1. Some liquid air was thrown upon a cake of ice. The ice was so warm compared with the air that it sizzled, the air assumed the spheroidal state and acted very much like drops of water on a red hot stove. A jet of steam in passing over a vessel containing some of the liquid air, was instantly frozen, and fell into a dish in the form of little hailstones. Supposing that the steam was only cooled down to the temperature of ice, it lost in an instant 1,290 deg. F. Some absolute alcohol was placed in a test tube and a string inserted, the whole being placed in the liquid air. In a short time the alcohol was frozen solid and was exhibited to the audience suspended by the string.

2. Its great expansive power was shown very strikingly by confining some of the liquid air in a closed tube and closing it up very tightly. In a short time the temperature of the room had caused so much of the air to expand that a great pressure was generated in the tube, which resulted in a sharp explosion and the blowing out of the stopper with a terrific force.

3. Liquid oxygen, although boiling at the low temperature of —299 deg. F., does not seem to lose its chemical properties as do a number of the active elements, prominently fluorine. An electric arc light carbon, heated red hot and inserted into the liquid burned brilliantly. Liquid oxygen has also the same chemical effects upon phosphorus and iron.

4. At very low temperatures a number of substances such as iron and tin become very brittle, breaking as easily as glass, whereas other materials, such as copper and aluminum do not change at all. The tensile strength of all materials increases as the temperature is lowered. At the temperature of —292 deg. F., iron has twice as great a strength as it has at ordinary temperatures. A wire that broke at 14½ pounds at ordinary temperature was cooled down and it was found that its tensile strength rose greatly, breaking only when the spring balance indicated a pull of 25 pounds.

Certain materials, such as ivory, when cooled down to this very low temperature, became phosphorescent when exposed for a short time to a strong light, as that from an ordinary arc lamp. This was tried with an ivory ball, and upon the room being darkened, it was found to be phosphorescent and had very much the appearance of a small artificial moon. An egg was found to exhibit the same phenomenon, though not to such a marked degree.

A tube containing liquid oxygen, having an outlet to allow for the free expansion of the liquid, was suspended by a silk thread, as shown in Fig. 1. As soon as the pole of a magnet was brought near it the tube was strongly attracted, proving that liquid oxygen is magnetic.

Dewar and Fleming found that the resistance of all the pure metals decreased greatly at low temperatures, and that the temperature co-efficient of resistance for all the pure metals, except platinum, increased as the temperature was lowered. The curves plotted tended to show that all the pure metals would become perfect conductors at absolute zero, or —273 deg. C. The fact that the change of resistance of platinum follows a straight line ratio, serves as a means whereby low temperatures can be measured merely by the change in the resistance of a coil of platinum at the different temperatures. The writer measured the resistance of a copper coil at ordinary temperature. The coil was then cooled down, though not to the temperature of the liquid air, as the supply of the latter was very nearly exhausted. He found that the resistance of the coil dropped from 1.8 ohms to about 0.6 ohms, showing a drop in resistance of about 70 per cent. Dewar and Fleming found that a coil of copper wire having a resistance of 17.5 ohms at 0 deg. C., fell to 1.65 ohms at —201 deg. C. If the temperature co-efficient for copper had remained constant along the whole range of temperature, it would have had a resistance of 3.43 ohms at this low temperature. The curves for alloys seem to show that the temperature co-efficient is approximately constant over very long ranges of temperature, the alloys having finite resistances at absolute zero.

The question whether liquid oxygen is a conductor or insulator seemed interesting. It was found, though very roughly, that liquid oxygen was a non-conductor of a specific resistance very much greater than that of distilled water.

The effect of low temperatures upon the magnetic properties of iron, was investigated by Dewar, who found that a magnet immersed in liquid air had its power increased about 50 per cent.

The practical use to which liquefied air may be put is of course very important, and will probably interest the public most, although it is hoped that the investigation of the effects of intense cold upon the properties of different materials may throw a good deal of light upon a number of scientific phenomena. The very low temperature of liquefied air, as well as its great latent power for the production of cold, renders it a very desirable product for purposes of refrigeration, and it is thought that this may prove, compared with present operative processes, a better and more economical method.

It has already been said that on account of the lower boiling point of nitrogen, liquid oxygen can be mechanically separated from the liquefied air. It is thought that the method for obtaining oxygen in this way from the liquid will compare very favorably in cost with the chemical methods now in use.

It is possible also, that the great expansibility of the air from the liquid to the gaseous form, producing great pressures when restricted in space, may be utilized as power to operate motors working by means of compressed air.

Manufacturing Aluminum and Its Sulphides.

AN interesting application of electrolysis to the manufacture of aluminum, sulphide of aluminum, etc., has recently been successfully caried out by D. A. Peniakoff, at Huy, in Belgium. The essential features of the process, according to the "London Electrical Review," are as follows: A single or double anhydrous aluminum salt, such as a fluoride or chloride, fused with the sulphide of an alkali or alkaline earth, together with a chloride or fluoride as a flux, yields a mixture containing aluminum sulphide, from which, in the same crucible, aluminum may be reduced, either by the action of an electric current, or by means of reducing gases (such as hydrocarbons, for example). The following formulæ present examples of the preparation of aluminum sulphide:

(1) $Al_2 F_6 + 3 Na_2 S = Al_2 S_3 + 6 Na F$.

(2) $Al_2 F_6, 6 Na F + 3 Na_2 S = Al_2 S_3 + 12 Na F$.

(3) $Al_2 Cl_6, 6 Na Cl + 3 Na_2 S = Al_2 S_3 + 12 Na Cl$.

When the bath is constituted according to the reactions (1) or (2), if aluminum be reduced from the fused mass, the supply of aluminum sulphide is kept up by additions of aluminum sulphate and carbon; aluminum fluoride and sodium sulphate are first formed, according to the equation $Al_2 3 SO_4 + 6 Na F = Al_2 F_6 + 3 Na_2 SO_4$, and the sodium sulphate is reduced to sulphide by the carbon, with subsequent production of aluminum sulphide, according to equations (1) and (2). It is stated that even where the sulphide of aluminum produced in the bath is subjected to electrolysis, the sulphide alone may undergo the electrolytic action, and not the fluoride, as the latter requires for its electrolytic decomposition a far greater electromotive force than that which suffices to bring about the decomposition of the sulphide of aluminum. Besides, where electrolysis is resorted to, the sulphur separated from the aluminum serves, for the most part, to reduce the alkaline sulphate to the condition of alkaline sulphide, thus adding its effect to the action of the carbon.

MR. GEORGE WESTINGHOUSE, JR., offers the entire electrical equipment as a gift to the proposed new Allegheny Observatory, comprising generators, motors, etc., of Westinghouse make.

CHICAGO LIGHTING.—The Comopolitan Construction Co. has been formed with a capitalization of $500,000, to build a $500,000 plant for the Cosmopolitan Electric Co., which claims to have laid already 75 miles of conduit for its work. The latter concern has a capital stock of $2,000,000. There is much curiosity as to the outcome of this scheme.

MAYOR VAN WYCK, of Greater New York, has vetoed the resolution to spend $35,000 on an electric light plant for the Recreation Pier at East Twenty-fourth street.

LITERATURE

PRACTICAL ELECTRICITY. By Prof. W. E. Ayrton. Volume I. London, 1896: Cassell & Co., Ltd. 643 pp.; 5 x 7 inches. Cloth. 247 Illustrations. Price, $3.50.

Prof. Ayrton's work, which appeared originally some ten years ago, was at once accorded a place among the standard treatises on the subject, and many a student has obtained his first inkling of the principles of the science from its pages. In more than one respect Prof. Ayrton's "Practical Electricity" differs from other works of the same general nature. Without desiring to disparage the good work of others, we think it may be fairly said that Prof. Ayrton has probably thrown more philosophy into his work than has any other similar writer, at least in the English language. By that we do not mean to say that the work is at all philosophical in the ordinary sense of the term; on the contrary, it is about as practical a work of its kind as could well be gotten together. In the elucidation of principles it is particularly strong, and the methods for bringing out the truths are exceedingly apt. The present volume which treats of current, pressure, resistance, energy, power and cells, has been completely re-written and is based on the international system of the electrical units. Both as a text book as well as an elementary laboratory manual the book stands without a rival.

ENGINEERING CHEMISTRY. By Thomas B. Stillman, Ph. D. Easton, Pa., 1897: Chemical Publishing Company. 523 pp.; 6 x 9 inches. 154 Illustrations. Cloth. Price, $4.50.

There is scarcely an industrial establishment of any kind which does not at one time or another require the analysis of material worked up or produced by the factory, not to mention many other tests which are desirable to obtain factory economy. Some handy work which will enable a fairly intelligent engineer to carry on an analysis, must be of the greatest value. Dr. Stillman has gotten together in the present work, a most comprehensive series of analyses, the complete list of which would alone occupy considerable space. We may, however, state broadly that we find therein full and complete direction for the determination of the amount and purity of metals, in most industrial salts employed, such as alum, etc.; lead, phosphoric acid, iron in ores, sulphur, carbon, etc. There is also an extensive treatment of coal and coke; analysis of water to determine the scale forming ingredients; composition of boiler scale; analysis of chimney gases; the manufacture of water gas and the calculation of heating power of various illuminating gases; practical photometry; the examination of the lubricating oils, of paints; pyrometry, etc.

We have selected but a few of the subjects treated of at random, but they will give a fair idea of the scope of this excellent work. Besides the complete direction for carrying out the analyses, all the apparatus required for that purpose is fully illustrated by the very clever engravings, so that those having even a limited knowledge of chemical analysis ought to be able to obtain results approximating closely to the truth The book is unquestionably one of the best of its kind which has yet come under our notice, and will be an excellent vade mecum for chemists, as containing the best of up-to-date methods.

INSTRUMENTS ET METHODES DE MESURES ELECTRIQUES INDUSTRIELLES (Instruments and Methods of Industrial Electrical Measurements). By H. Armagnat. Paris, 1898: Georges Carré et C. Naud. 586 pp., 5 x 8½ inches. 175 Illustrations. Flexible covers. Price, $2.40.

As chief of the bureau of electrical measurements of the Carpentier Laboratory, the author has had unusual facilities for acquiring the experience to fit him to undertake the work before us. He says very truly, that beginners lack most generally the knowledge of measuring instruments, their qualities, and particularly the limits of their employment. The book is divided into two parts, the first of which treats of the general principles embodied in measuring apparatus, the second part being devoted to the description of actual methods of measurement in general use, with full direction for carrying them out.

While the author has not entirely eschewed mathematics, a knowledge of them is essential to the complete understanding of the work, but even those little familiar with their application will find enough in it to make it valuable to them. The illustrations also will be found very helpful, representing as they do a good collection of standard measuring instruments in use at the present time.

ELEMENTARY MANUAL OF MAGNETISM AND ELECTRICITY. By Andrew Jamieson. Fourth edition. London, 1897: Charles Griffin & Co., Ltd. 297 pp.; 5 x 7 inches. Cloth. Price, $1.40.

This manual is too well known to require a detailed review at this late day. The present edition has been revised and brought fully up to date. For compactness and directness of application of the principles to practice, we know of no more valuable aid to the beginner. The illustrations are admirable and chosen with evident care. The book can be highly recommended in every way.

PATENTED TELEPHONY. Published by the American Electrical Engineering Association. Chicago, Ill., 1897. 5½ x 7½ inches. 102 pp.; 27 Illustrations. Cloth. Price, $1.50.

In these days of fierce telephonic competition, calling into existence many types of telephonic apparatus, not a few are interested in the ever present patent question; for although the sky of telephonic litigation appears serene at the present time, there is probably no telling when the storm may break forth again, and to be fore-warned is fore-armed.

The present volume presents a review of the patents pertaining to telephonic apparatus, and although in a small compass, gives the result of a considerable amount of research. It abstracts from the specification and claims of most of the so-called "controlling" patents still in existence, and is, one may say, a very good résumé of the present state of the telephonic art. All engaged in telephonic work will probably find much to interest them in its pages.

The "conclusions" given at the end of the volume will make interesting reading to many in the ranks of the "opposition" as well as those in the Bell camp.

GREELY'S SIGNAL SYSTEM FOR THE COAST. General Greely, Chief of the Signal Service of the army, is hastening the completion of plans for establishing a system of telegraphic communication along the coast from Portland to Jacksonville. Between New York and Savannah the Weather Bureaus maintain several sections of telegraph lines. These will be connected. It is proposed to erect at stated distances along the coast signal stations. They will be of uniform pattern, to cost about $2,000 each. Semaphores will be used to communicate with vessels at sea. To General Greely has been allotted $100,000 out of the emergency fund of $50,000,000, which will be used in perfecting the signal service.

CHICAGO POLICE TELEPHONES.—Every police station is soon to have a public telephone, so that citizens may call for help without having to rush around to discover a policeman. City Electrician Ellicott has also replaced the gravity batteries with storage batteries in the police and fire departments, effecting a saving of $5,800 a year.

ILLUMINATING PITTSBURG.—The Knights Templar Committee at Pittsburg, where the next triennial conclave is to be held, has closed a contract with the Sawyer-Man Co. (Westinghouse), for 30,000 lamps of 16 candle-power, with which to illuminate arches and buildings.

MR. C. H. BOOKOUT, who is a full-blooded Indian, has become station agent at Wilmore, Kan. He was once a section hand, but studied telegraphy.

CHICAGO TELEPHONE CO., in case of war, has proposed to notify all its 18,000 subscribers by telephone inside of twenty minutes.

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Emasculating the Broad Patent on the Trolley.

THE full text is given in our Legal Notes this week of the decision in the U. S. Circuit Court of Appeals reversing the order given for an injunction under the broad Van Depoele patent, against the Union Railway Co. and the Walker Co. as manufacturing the underrunning trolley, alleged to infringe. This virtually ends the contention, for a time anyhow, and leaves open to the public the use of the trailing, freely mounted trolley arm pressing upward against the service conductor. The matter in various forms has had such diversified shape and fortune that even those interested in electric railway work have lost the run of it. If we recall the facts aright, the Van Depoele patents, always regarded as a valuable asset of the Thomson-Houston Company, were brought to bear against the Westinghouse Co., to exclude them from street railway work, and the decision of Judge Townsend, in 1895, sustaining one patent, was a decided victory for the General Electric Co., preceding, and probably helping to precipitate, the federation of the two concerns. The Walker Co. then involuntarily took up the gage of battle, and is to be credited with carrying through a difficult struggle to its present pronounced success. In what is known as the "Hoosick case" the lower court upheld Judge Townsend's decision, but the Circuit Court of Appeals, through Judge Wallace, decided the case in favor of the Walker Company, holding the patents invalid as to five of the claims, and thus practically reversed the Townsend decision.

The fight then reverted to two other claims. In February last, Judge Lacombe decided in favor of the patent on these two claims, but the Circuit Court of Appeals has just reversed the decision, and has practically held the entire patent void.

The decision, as in the Hoosick case, is that Van Depoele took out an earlier patent for substantially the same invention, although with narrower claims. That earlier patent is in force, and will probably remain in force for some years, but its claims are narrow and have been so construed by the same Circuit Court of Appeals in the "Elmira case." The data as to these points will be found in the decision itself, which would appear to leave the making and use of the underrunning trolley broadly open. It is not to be forgotten that these U. S. Circuit Court of Appeals' decisions are practically final in patent litigations. We think there can be little question as to the value to the art of the late Mr. Van Depoele's pioneer work, but such decisions, so far as they are operative, show once again that it is as dangerous to patent too much and too often as it is to patent too little or not at all. "Broad patents" once secured, are best let alone for what they are worth. The Walker Co. has had no small courage in making this uphill, dubious fight, and even should further struggles impend, is in a position to reap decided advantage from it. We print elsewhere the view taken of the situation by the General Electric Co.'s legal advisers.

General Electric Affairs.

PERSISTENT rumors, now believed to be well founded, have been afloat as to an early readjustment of the finances of the General Electric Company. It is certainly high time, for there is no question that it is a detriment to any line of industry to have its largest producer in prolonged non-dividend paying condition. At the present moment, dividends on preferred General Electric stock have accumulated up to 35 per cent., or just five years at 7 per cent., and that on $4,250,000 preferred is about $1,500,000. The $30,460,000 common stock has got nothing in a like period. The impairment of capital, avowed, is about $13,000,000 and no dividends can be paid until that is repaired in some way. The company has an enormous productive capacity and is as busy as it can be. Indeed, one result of the huge capitalization of the company is that it has engaged in many lines it might well let alone, in order to secure a huge turnover, justifying that capital's existence, running up with the bonds, over $40,000,000.

It is said that the new plan will go through, and as now understood it is as follows: The capital impairment is to be made good by reducing the thirty millions of common stock 50 per cent., making the amount of that class of shares outstanding some $15,000,000. The claims of the preferred stockholders to unpaid dividends are to be settled by turning over to them some $2,000,000 of 5 per cent. debenture bonds of the company now in its treasury. This, it is said, would be acceptable to all interests, and, upon the basis of the current earnings, the company would be able to pay 4 per cent. annual dividends on the reduced amount of common stock. This plan will probably be submitted at the company's annual meeting in May if present hopes are realized.

Prof. Fleming's Use of the Heavisidian System of Nomenclature.

IN his recent lecture on "Magnetism and Diamagnetism," before the Royal Institution, Prof. Fleming made use of the rational system of units proposed by Mr. Oliver Heaviside, which once again calls to mind the necessity of a universal adoption of units and definitions. It will no doubt take some time before electrical engineers are in a position to use the terms fluxivity, retentivity, magnetivity, coercivity, and gaussivity, etc., correctly, for even Prof. Fleming inadvertently made use of the term "magnetic force" for "gaussivity" several times during the course of his lecture. He also urges great objections to the use of the term "force" in connection with any other idea than that of change in momentum of material substances. Instead of employing the term "magnetomotive force," he believes it would be better to express the same notion by speaking of it as the "gaussage" of the magnetic circuit. The magnetomotive intensity or gaussage per linear centimetre might be called the "gaussivity" acting on the circuit at the specified place. The principal magnetic facts could then be expressed by the simple statement that gaussage (measured in ampere turns) produces magnetic flux (measured in webers) in magnetic circuits. The intensity of this cause or effect is described by stating that the

gaussivity (in ampere turns per linear centimetre) produces in the circuit a certain "flux density" or flux per square centimetre. The "reluctance" of the magnetic circuit is that quality of it in virtue of which gaussage is required to produce "change in magnetic flux." The "reluctivity" of a circuit at any place is the reluctance of a cubic centimetre of it at that place and under the assigned conditions. The "retentivity" is that magnetic quality of the material in virtue of which magnetic flux persists after gaussage is withdrawn. The "coercivity" of the material is that magnetic quality of the material in virtue of which a reversed gaussage is required to annul or wipe out magnetic flux. This nomenclature certainly appears to be very reasonable and acceptable, and one which should commend itself to every teacher and student of electricity and magnetism. If it does meet with the approval of the scientists of this country, we should advise its speedy introduction into our colleges and text books, following the splendid example set by Prof. Fleming. If, on the other hand, the system has inherent faults which may become apparent, and might confuse rather than simplify matters, the proposed system should at once be made the subject of a discussion having for its final object the introduction of a system of nomenclature which will be acceptable to all.

The Electrical Exposition and War.

WE publish on another page the latest list of participants in the approaching Electrical Exhibition, and surprisingly large as it is, we understand that many other names are being added. The grim uncertainties of war might discourage some exhibitors if it were not known as an actual matter of fact and experience that at such times places of amusement are fuller than ever, it being difficult for people to stay at home in their houses while big events are taking place and while vital news may come at any moment. Moreover, it may be surmised that an art of which so many branches touch upon the implements of warfare will have numerous things to demonstrate of peculiar interest and importance at such a season. The exhibition management has, to our knowledge, been pursuing a highly liberal policy in the provision of special features, some of which have already been noted in our columns; and we are certain that when the full result is seen, both the public and the exhibitors will be not only pleased, but gratified and delighted.

After all, in these modern days, "peace is long" and war is short, and in the realms of peace electricity has a future of unbounded prosperity and magnitude. But there is still a tremendous amount of work to be done in educating the general public up to the approval and purchase of the novel electrical appliances as they come forward; and these exhibitions are in some respects unequaled as factors for that purpose. The electrical press is steadily doing a great work in all directions in behalf of the interests it represents, and its public spirit has been shown in the zeal with which it welcomes every new agency that can aid it in the work. But people who are loathe to read technical literature can be quickly reached through the eye and ear, and an impression is thus made which lasts and becomes fruitful.

Electricians in the Navy.

IT is announced that an executive order of the President has established the ratings of chief electrician, electrician first class, and electrician second class, to be taken from civil life for service in the navy. They will be required to pass a physical examination and professional examination at the Navy Yard, New York, before a board that will be established. The pay will be $50, $40 and $35 a month, with rations. This will be interesting news to many who have watched the gradual introduction of electrical apparatus into the U. S. Navy for a large variety of uses. In the early days, the care of electrical work was entrusted to one of the junior officers with tastes for electricity, but now there is enough electrical apparatus on board any up-to-date man-of-war to keep two or three competent electricians busy all the time. The salaries named are not large, and certainly will not command the best talent on the market, but the probability is that such berths will offer inducements to many well informed young men willing to serve their country afloat.

The Telephone as a Life Saver.

IN view of the fact that there are excellent telephones for divers' helmets, it is hard to explain or excuse the recent death of a diver at Key West. It appears that Chief Gunner's Mate Johnson, of the gunboat Newport, was asphyxiated last week while in a diving suit examining the ship's bottom. It was the usual quarterly examination. The air pumps were kept working regularly. The diver gave no signal to be hauled up. At last the tenders became alarmed and pulled him up. He was dead in his suit. The cause of the asphyxiation is not yet clear, but it is supposed that the air pipe fouled at the bottom, and was squeezed so as to cut off the supply of air. We may be wrong, but the mere tinkle of a bell from below, or the cry of distress to anyone listening at the telephone would be sufficient to prevent such deaths, and the apparatus costs so little!

General Electric View of the Trolley Decision.

AS we go to press, we are in receipt of the following from the General Electric Co., in regard to the trolley decision of the U. S. Circuit Court of Appeals :—

"The decision rendered by the Circuit Court of Appeals in the suit brought by the Thomson-Houston Company against the Union Railway Company under Van Depoele under-running patent No. 495,443, is not final but came up under a motion for a preliminary injunction. It is understood that testimony is now being taken, and that the case will be pushed to final hearing in the immediate future. The decision of the Circuit Court of Appeals was to the effect that an injunction should not be granted pending the final hearing.

"This is but one of a number of trolley patents under which the Tomson-Houston Company is suing various manufacturers or users of the infringing trolleys. Among the other suits is one under Van Depoele patent No. 424,381, the special feature of which is the use of a tension spring occupying a horizontal position and pressing the trolley arm upward. This construction is universally used as it permits the trolley arm to be brought down close to the roof of the car. Another patent under which suit is pending is No. 502,243, which relates to the use of oppositely acting tension springs, of which one set "rests" while the other is in use.

"Another patent of Van Depoele under which suit is pending is No. 495,383, which covers the reversible trolley, that is to say, one which may swing freely around its vertical axis so as to trail in either direction.

"Two other cases will be argued during the present week, one on the Anderson patent No. 412,155, and the other under the Baker patent No. 437,961. These patents relate respectively to means for conducting current from the trolley wheel to the harp, and to the use of buffer-springs for checking the motion from the trolley arm when it escapes from the wire.

"All the principal manufacturers are under injunction with reference to the Van Depoele switch patent No. 424,695, this patent having been sustained at final hearing.

"In view of these several patents relating to the essential features of the under-running trolley, the effect of the decision of the Circuit Court of Appeals does not throw the under-running trolley open to the public; the switch patent alone practically controls the situation, as it is impracticable to run a road of any considerable size without the under-running switches."

Considerations Governing the Design of the Crocker-Wheeler Slow Speed Motors.—III.

BY GANO S. DUNN, CHIEF ENGINEER.

THE details of these motors have received equally careful attention The brush-holding "rigging" is shown in Fig. 7. The design adopted is particularly desirable where the number of poles is large. Two carrying rings are used, which, while mechanically supporting the brush rods, connect them electrically, the rods being fastened to them. One of these rings holds all the positive, and the other all the negative studs. The rings are insulated from each other, but are mechanically one, and shifting of brushes is obtained by moving them just the same as a purely mechanical holder would be moved. The rings therefore do away with the insulating of the brush rods and the connecting of the alternate studs by cables. On account of the room saved by this arrangement, the carrying rings can be placed next to

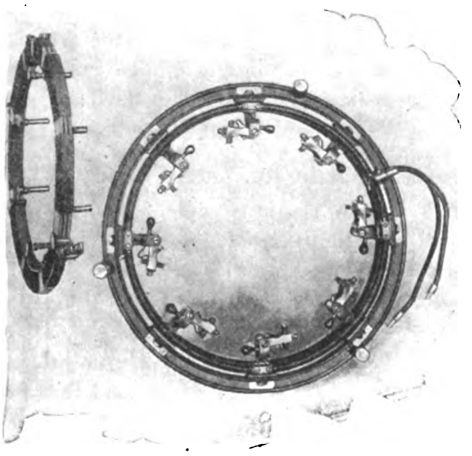


FIG. 7.—SIZES 5-100 TO ½-100 C. W. MOTOR BRUSH RIGGINGS.

the armature, permitting the studs to point outward and over the commutator, which enables a brush holder to be withdrawn for cleaning or adjustment even while the motor is running. The keeping of the carrying ring close to the frame, not only leaves the commutator clear and easy of access, but greatly enhances the pleasing appearance of the motor.

The commutators, being for machines of many poles, are of large diameter and short, and have a great many bars. The connections from the armature are made to tails riveted to each bar and these are long enough to prevent the melting of the solder holding the wires in place in case of serious overheating from the action of the brushes or other causes. The armature has an extended sleeve upon which the commutator is keyed, so the whole acts as one part.

Before passing to the description of methods of control adopted, the writer would point out a characteristic of low-speed motors which in certain cases gives them an important advantage over others. Their moment of inertia is low and permits starting from rest in a minimum of time and with a minimum of current. The energy necessary to bring a rotating body to a given speed is, in the case of an armature, approximately proportional to its weight, its diameter, and the square of its speed. If we compare a size 2 standard armature, giving 2 h. p. at 1,000 r. p. m., with a size 2-100 armature, giving 2 h. p. at 100 r. p. m., we shall find that the product of the moment of inertia by one-half the square of the angular velocity of the former is 900 foot-pounds, while for the latter it is 280 foot-pounds, or nearly four to one, in spite of the fact that the high-speed armature weighs only one-fifth as much as the other. This means 3.2 times as much work must be expended upon the armature of the high-speed motor to bring it from rest to normal speed as is necessary for the low-speed one; where the duty the motors have to perform requires quick and frequent starting and stopping, as with elevators and cranes, the driving of roll tables in iron mills and in printing press work during the time of "making ready,"

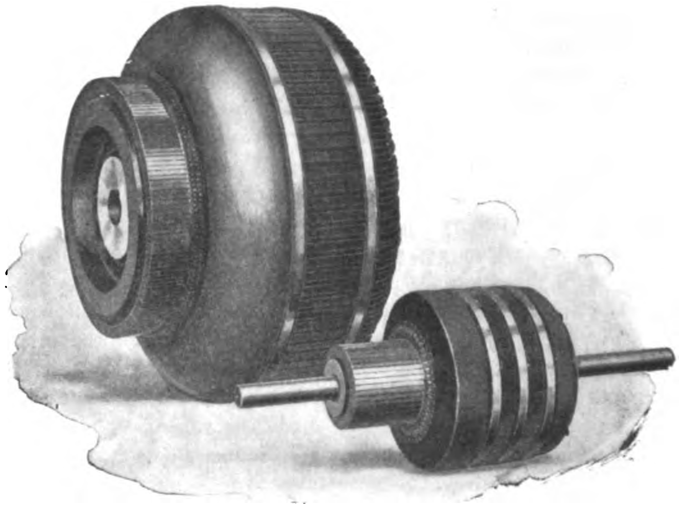


FIG. 8. COMPARISON OF ARMATURES OF MOTORS.
(Size 2-100, 8 pole, 2 h. p. at 100 rev., with size 2, bi-polar, 2 h. p. at 1,000 rev.)

this difference is very noticeable and plays an important part in the economy of the plant. Fig. 8 illustrates graphically the comparative sizes of these armatures.

REGULATION AND CONTROL.

The regulation, or constancy of speed, under variations of load of the shunt wound slow motors, depends greatly upon the speed for which they are wound, since it is largely dependent upon armature resistance, which, as we have seen, varies with the square of the speed. For the speeds at which

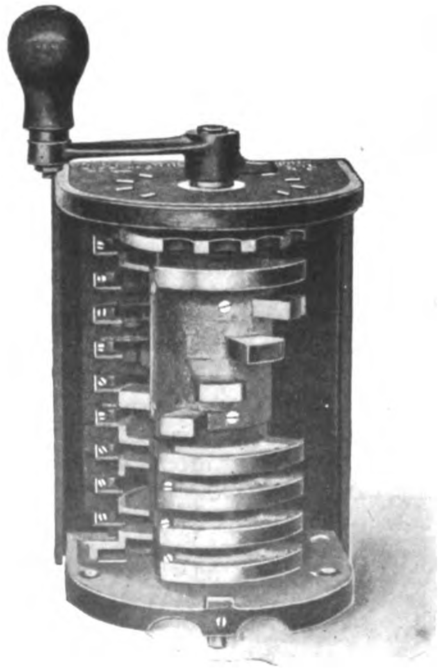


FIG. 9. 25 AMPERE COMMUTER.

the motors usually run, which is in the neighborhood of two hundred revolutions, the regulation is much less perfect than for high speed motors. A 5 h. p. standard motor at 950 revolutions will slow down 4 per cent. when full load is thrown upon it; but a size 2-100 giving 4 horse power at 200 revolutions per minute will reduce its speed about 15 per cent. under the same conditions. This imperfect regulation does not make itself felt,

however, for in most of the work of these motors there is a large element of constant load which makes any variation only a small portion of the total, and is, consequently, accompanied by a variation in speed, which is only a small portion of the full load speed variation.

In these motors there is a demand for a control of speed over a considerable range, which is met by designing them with distant sparking limits, so that the field may be much weakened and the speed correspondingly increased without trouble at the commutator. In shunt machines the field is controlled by an ordinary rheostat, or is wound in multiple sections, whose circuits are opened successively. Series wound motors have their speed controlled by the short circuiting of various portions of the field in certain order.

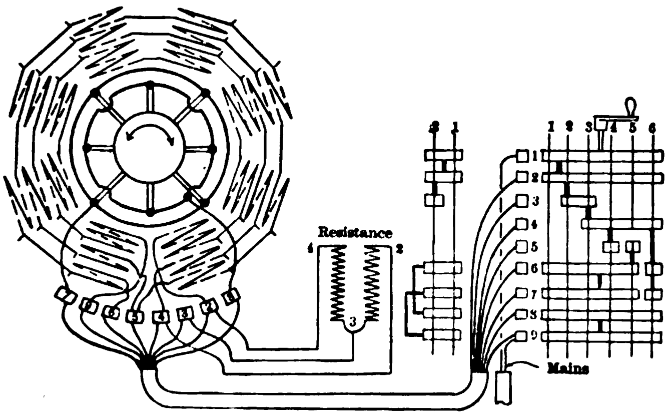


FIG. 10.—REVERSING COMPOUND-WOUND DIRECT MOTOR WITH COMMUTATOR.

Compound wound motors, the kind sometimes used for printing presses, have a constantly excited shunt field, supplemented by a series field in two sections, the whole controlled by a controller of special design; or they may have an unvaried series coil, with a shunt coil whose strength is changed by a field regulator in the well-known way.

To increase a motor's speed by weakening its field is so easily accomplished that it is not appreciated how severe are the conditions it imposes, conditions which, were they not met by special design, would be impossible for the motor to withstand, and with which it is difficult for even special design to cope.

It is well known that sparking at the commutator depends largely upon the character of the magnetic fringe around the edges of the pole shoes, and that it is also dependent upon the amount of current flowing in the armature. The weakening of the motor field, which compels the armature to increase its speed, weakens simultaneously the magnetic fringe which is relied upon to perform the operation of commutation, or the proper reversal of current in each little section of the armature when passing the region of the brush. This reversal, no longer properly accomplished, causes sparking, which sooner or later destroys the commutator.

But the weakening of the fringe is not all. The increase of speed causes the motor to do more work or develop a greater horse power. This draws proportionally more current from the line, putting upon the armature, already struggling with the burden of commutating in a weakened fringe, the additional burden of an increase of load. It is needless to point out how the 50 per cent. increase of armature current causes a more than doubled heating of the conductors.

From the foregoing it might be inferred that a motor rated for the maximum speed and output would solve the problem, but, unfortunately, even more than this is required, for such a motor would not be capable of reaching the lower speeds, as its field magnets would be saturated.

Having described the difficulties that apparently simple speed regulation involves, we will explain how they have been met in these motors, all of which are capable of an increase of 50 per cent. above normal, and a decrease of 10 per cent. below normal speed.

The magnetic fluxes employed for normal speed are much in excess of the fluxes required; therefore, when the weakening has taken place, there still remains a proper strength for commutation. This excess of magnetic flux obviously involves a corresponding increase in the size, weight, and cost of the magnetic circuits of the frame and armature. The increase of the load accompanying the increase of speed, which tests most severely the sparking limits, is provided for by proportioning the commutator and brushes so that they will appropriate more than their usual share of the labor of commutation, and prevent the sparking that would occur as a result of the overloaded armature's reaction upon the weakened fringe. This involves a large commutator with small differences of potential between the bars and large allowance of brush area, subdivided to obtain as much commutating edge as possible.

The speeds below normal are obtained by pushing to full saturation the iron worked normally, for reasons of efficiency, to only a moderate portion of what it is capable, and by utilizing the resistance of the series coils when they are employed, to cause a slight reduction of voltage. This forcing requires considerable field energy, but the exciting coils are designed not to be overheated by it, and the only drawback is a slight reduction in efficiency at the very lowest speeds.

The speed variations we have just described are accomplished without the introduction of external resistance into the armature circuit, and if it should be desired, they may be accomplished without the use of a regulator in the field circuit; but as a rule, this is the most convenient means of control, and, since it operates on the extremely small field current, the losses it involves are insignificant. Throughout the speed range we have been describing, the motor's regulation is not sensibly impaired. At whatever speed the regulator calls for, the motor will run constantly within the limits set for it.

Although a range from 10 per cent. under to 50 per cent. over normal speed, or 60 per cent. of normal in all, is great enough to meet almost all conditions, additional range may be had at the lower limit by the employment of resistance in series with the armature. For many classes of work the loss of constancy of speed which this involves is of no importance, since the load does not appreciably vary, and, under these circumstances, it is possible therefore to increase the range of speed control from 50 per cent. above to 50 per cent. and even 75 per cent. below normal.

These motors may be connected as plain, shunt, series or compound. The great objection to the series winding is that unless the current which a motor will take when running a given machine is accurately known, and the motor wound for that current, it will not run at the right speed when driving the machine, because its field strength and drop in voltage in the field coils will not be as calculated. Another objection to the series winding is that if the load fluctuates the speed will also vary widely.

The advantages of the shunt winding are: Constant or very nearly constant speed under all variations of load, and simplicity of control, which is effected by means of a regulator in the field circuit which wastes very little energy. The shunt motor is started and reversed by means of a controller and small resistance, which is entirely cut out of the armature circuit when the motor attains normal speed.

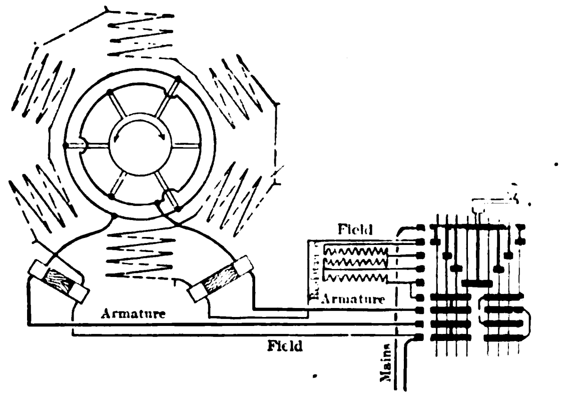


FIG. 11.—REVERSING SHUNT-WOUND DIRECT MOTOR WITH CYLINDER REVERSER.

The chief advantage of the compound winding is seen when the motor is under variable or "lumpy" load. The series coil of the field winding gives added field strength with increase of load, and, besides, by increasing the counter electromotive force, reduces the momentary excessive rush of current that would

otherwise flow, and which might cause dimness of nearby lights, or drop in speed of other motors. The shunt coil makes the speed less dependent upon the work of the armature than in the series motor. As explained above, the series motor varies widely in speed with the current. With the compound motor the power may vary within wide limits without a marked effect upon the speed.

CONTROLLERS.

Two kinds of controllers have been designed for these slow motors; the ordinary cylinder reverser, giving as many speeds backward as forward, operating through a resistance having one

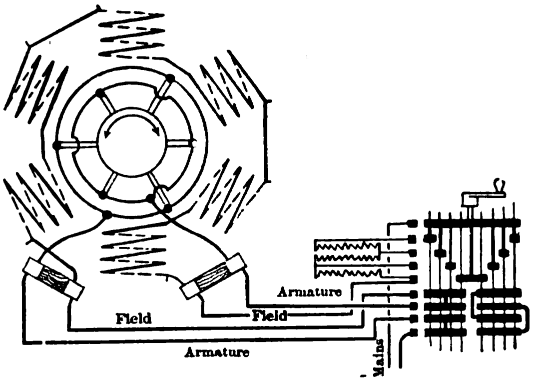


FIG. 12.—REVERSING SERIES-WOUND DIRECT MOTOR WITH CYLINDER REVERSER.

section for each speed, and regulating the speed of the motor by cutting down the voltage supplied by the line in the usual manner.

This cylinder reverser with a small resistance serves as a reversing starter for a compound motor, which has an unvaried series coil, but which has a shunt coil, that is weakened or strengthened by means of a field regulator. This method of controlling the speed of the compound motor by varying the strength of the shunt coil is so simple and well understood that we deem further explanation of it unnecessary.

The other kind of controller is what is termed a "commuter," specially designed for use with a compound motor, used principally for printing press work, but applicable to other work as well. It varies the speed of the motor after it has once started it, by adjusting the field strength by changes in the connections of the various series field coils. In this commuter, by a system of closed circuits through the field windings, parts of which it

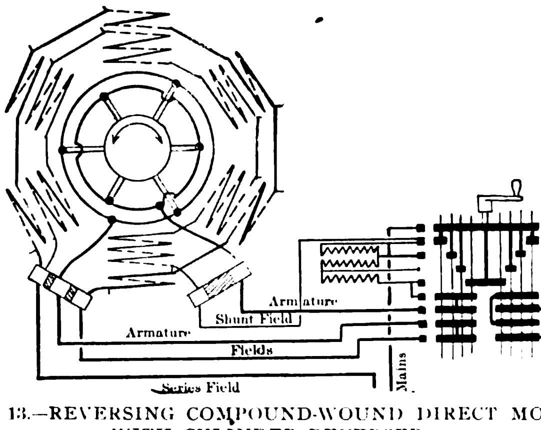


FIG. 13.—REVERSING COMPOUND-WOUND DIRECT MOTOR WITH CYLINDER REVERSER.

short circuits in proper order, arcs are avoided at all points except those actually engaged in opening the circuit to stop the motor, and these points, in addition to being made as durable and heavy as possible, are renewable, permitting the substitution of new ones when they have finally become too burned to be of service. In order to distribute the duty at stopping, the circuit is broken simultaneously at eight points, so that the arc is minimized and distributed. Fig. 9 shows the general appearance of a 25 ampere commuter, and Fig. 10 shows diagrammatically the connections, while Figs. 11, 12 and 13 show the connections for the cylinder reverser.

The Regulation and Protection of the Electric Motor.[1]—I.

BY HARRY H. CUTLER.

ELECTRIC transmission of power is fast becoming recognized as capable of almost universal application to all kinds of machinery. Scarcely a meeting of manufacturers, trade associations, or engineering societies takes place where something of a favorable nature is not said about this rapidly growing and important industry. It can be truthfully stated, however, that the public is only just beginning to recognize the adaptability of the electric motor, and that an enormous demand awaits it in the near future.

We now see motors not only fast displacing belts and shafting, but also operating many kinds of machine tools, traveling cranes, hoists and elevators, pumps, ventilating fans, printing presses, mining machinery, dredges, street cars, railways, vessels, air ships, implements of war, telescopes and scientific apparatus, and in fact almost every conceivable application of power.

Now there is one peculiar feature which comes up with each and every motor that is installed, namely, that a connecting link between the motor and what it is to drive must be provided which shall be adapted to the peculiar kind of work to be performed. This connecting link is the rheostat or controller, and the rapidly growing demand for these devices has given rise to what could almost be called the profession of rheostat engineering. By means of the rheostat or controller the motor is started and stopped, its direction of rotation is determined upon, and the speed at which it shall rotate is varied at will.

The same motor which drives a pump would drive a fan, a printing press, or a line of shafting as well, but the proper type of rheostat to use for these various applications of power would be vastly different in each case. Generally speaking there are but three kinds of direct current motors, the series, shunt and compound wound, and the best suited of these three types of motors is selected to do the work. The types of rheostats for controlling these motors, however, are so numerous that only a few can be mentioned in this paper.

By far the largest number of stationary motors in use to-day are direct current, plain shunt wound, non-reversing, and run at a constant speed. These motors are usually provided with motor starting rheostats, whose resistance is in circuit only during the few seconds consumed in starting the motor. Simple as these rheostats are, great care should be taken in selecting the size and style best suited for the work.

A motor that is started and stopped but two or three times a day can be satisfactorily handled with a starting rheostat that would frequently be almost useless for starting and stopping a motor two or three times a minute. A rheostat arranged to start a motor under full load to the best advantage will not start a motor equally as well at 100 per cent. overload. A rheostat satisfactory to the Fire Underwriters of Chicago is not necessarily adaptable to the New York authorities, and would be looked upon as unnecessary extravagance by the country trade. It is important then, even in the very simplest cases, that the character of the work should influence the selection of the proper starter or rheostat, and when it comes to applying a motor to almost any other use than that of driving belts and shafting, this question becomes of still greater importance. Most stationary motors are operated at constant speed, but consumers of power are finding out that the speed of a motor can easily be regulated at will and are calling for appliances which will accomplish this.

I can almost say that there is but one way by which the speed of a motor, of direct current, can be changed, and that is by changing the voltage across some of its parts or windings. There are a great many ways to accomplish this. The simplest, but unfortunately the most unsatisfactory way of reducing the speed of the motor, is to reduce the voltage across the armature by inserting external resistance in series with it. This method is uneconomical on account of the current absorbed by the rheostat, and also destroys the self-regulating property of the motor. The speed of a shunt wound motor varies approximately with the voltage across the armature or brushes; with external resistance in series with the armature, the speed will vary to a much greater extent for the following reasons: When the load on the motor is increased, the current, C, must increase.

[1]Read before the Chicago Electrical Association, April 1, 1898.

This increase of current can only occur by a decrease in speed which lowers the counter electromotive force of the armature, thereby permitting more current to flow. But the current, of course, has also increased in the rheostat, while the resistance, R, of the rheostat has, unlike the armature resistance, remained the same, hence, since $C = \frac{E}{R}$ we see that the electromotive force, E, across the rheostat, must be increased in the same way, in order to allow more current to flow. This increase can be derived only by slowing down the armature, and reducing its counter electromotive force. A very slight increase in the load when external resistance is in series with the armature will then often actually stop the motor entirely. Such cases as this have been so frequently causes of complaint from customers, that It would appear that the effect of external resistance in series with the armature is not at all well understood by either users, owners or salesmen of electric motors in general. The prevailing opinion seems to be that a speed regulator of the above type can be set so that the motor will run at a certain speed, independent of the load. In proof of this assertion, many orders can be shown from some of the largest manufacturers of motors in the country, calling for a certain number of steps in the regulator to give a corresponding number of fixed speeds for the motor.

Another method of changing the voltage across the armature is to operate the motor on a three-wire system, and connect the armature across the outside wires for high speed, and between the neutral and one of the outside wires for low speed. This method wastes no current, and causes the motor to assume a definite speed independent of the load.

Still another method, which is ideal so far as the motor regulation is concerned, is to connect the armature across a variable number of storage batteries, thus obtaining any desirable speed over wide ranges. Another method consists in so winding the armature that the coils may be changed from parallel to series, which can be accomplished in several ways.

Altering the voltage across the field of a motor also affects its speed, but in exactly the opposite way from that caused by changing the voltage across the armature. To increase the speed of a motor we can decrease the strength of its field, and there are many ways of doing this. The simplest and one of the best is the insertion of external resistance into the shunt field circuit. This method is not only very simple and inexpensive, but unlike the armature regulation through resistance, it wastes comparatively nothing in heat and allows the motor to assume the desired speed and maintain that speed independent of the load.

Motors are to be had of nearly all the large builders which will operate satisfactorily with a field variation of 50 per cent. in actual ampere turns. The same result is frequently obtained by using a compound wound motor, winding the series fields in separate sections and cutting out these sections one by one by means of a special switch. At least one manufacturer goes so far as to use so many of these field sections that their resistance is sufficient to prevent more than the proper amount of current from flowing, on closing the circuit, without using any external resistance whatever. The series windings are then cut out one by one as the armature revolves. A very powerful starting torque and a wide range of speed is thus obtained. This method, however, will not regulate the speed independent of the load, as the field strength cannot be kept constant. It is applicable, therefore, chiefly to cases where an attendant is constantly on hand, as in the case of elevators, cranes, and hoists.

One more method of varying the field strength consists in throwing the winding of the field cores into series connection for high speed, and series multiple for slow speed.

Motors are sometimes regulated by means of using a separate generator for each motor, and varying the voltage of the generator by means of its field rheostat. This method is known as the Leonard system, and gives perfect regulation over a wide range.

We have now before us a long list of methods from which to choose the system of regulation best adapted for the work at hand. One of the simplest and best is that frequently used for regulating motors driving fans and blowers, by means of so-called compound speed regulators. No large office or school building is now considered up to date which is not provided with artificial ventilation, which can be regulated at will.

The motors which drive the fans are so belted or geared to the fan that when the fan is operating at the average speed desired no external resistance of any kind is in circuit. To reduce the speed, the rheostat lever is moved to the left and resistance is cut into the armature circuit, and to increase the speed the lever is moved to the right and external resistance cut into the shunt field circuit.

To select the proper sized motor and to determine upon the proper speed to run the fan, requires an accurate knowledge of and experience with fans, air ducts, and the laws of moving air. This is another subject which has not been reduced to a science by fan builders. Some builders always use a series wound motor for driving fans, and others have adopted the shunt wound motor. When it is not necessary to vary the speed of a fan, the series motor is probably preferable as being simpler, but for driving large fans where speed regulation is always desirable, the use of a plain shunt wound motor and a compound wound regulator appears to be the best practice.

In proportioning the resistance for a fan regulating rheostat it must be borne in mind that the power required varies directly as the third power of the speed, and not directly as the speed as in driving shafting and machine tools. A regulating rheostat for a fan is therefore designed on entirely different lines, even the contacts and mechanism are different, because a fan is never started and stopped at frequent intervals during the day, and a cheap button front will do the work satisfactorily.

Diametrically opposed to the fan regulator is the electric elevator controller. This work calls for continually starting and stopping several times a minute, all day long. Heavy, renewable contacts are absolutely necessary, as well as a special type of motor, and problems of entirely different character are to be met with. It is not practical to build an elevator controller all ready to fasten to the wall, with a string hitched to it for the operator to pull. Such devices are on the market in abundance, but should be regarded as a source of great danger.

An elevator controller to be safe should be embodied into and form a distinct part of the elevator mechanism and should be attached to the elevator mechanism by the elevator manufacturer, and not by the motor manufacturer or their selling agents.

There are a great many good methods of operating electrical elevators on the market. Among these methods in most common use is the system which uses a compound wound motor and compound regulation. The motor is started through external resistance, which can consist of a rheostat or the windings of the series coils themselves. This resistance is then cut out in several steps under control of some kind of a governor; the series field coils are then cut out and finally the shunt field is weakened by the insertion of external resistance. The operation of electric elevators brings up the problem of: How to reverse an electric motor. To accomplish this it is only necessary to change the relative direction of the current in either field or armature circuits. The moment we do this, however, new trouble arises. Means must be provided to prevent the possibility of reversing the direction of the current without either first stopping the motor or at least inserting external resistance into the armature circuit. Means must also be provided to prevent excessive sparking or burning at the switches as well as undue strain on the insulation of the motor.

In order to reverse a motor the field and armature have to be controlled by independent circuits. Whenever a circuit is suddenly opened that contains coils of wire wrapped around a mass of iron, a secondary or induced current is formed, which has a potential many times higher than that of the primary current. This current not only burns the switches, but is sure to puncture the insulation of the motor, sooner or later, unless means are taken to prevent it. Many designs of elevator controllers and rheostats on the market try to overcome sparking by opening the circuit with a snap switch, but electricity cannot be fooled in any such a simple mechanical manner as this. The flash and consequent strain on the insulation of the motor is only increased the more, and all that is gained is that the switch does not burn up so quickly. This is no dream, but it is an actual fact that the market is flooded with rat trap devices which claim to eliminate sparking by means of snap switches. A snap switch is well enough for use in a lighting circuit, but when used in connection with a reversible motor it is a constant menace to the safety of its insulation. Everyone knows, who has handled a motor, that if the double pole knife switch is pulled even when the motor is heavily loaded, a destructive spark is never obtained. The reason for this is that the armature and

shunt fields are not separated, and consequently no induced current is formed in either and no strain whatever on the insulation occurs. The motor becomes a generator, energizing its own field and gradually slows down and loses its magnetism. A similar condition of affairs can be obtained on a reversible motor. Before opening either the field or armature circuits, both sides of the line should be opened simultaneously, which of course will cause no sparking as just pointed out. External resistance should then be inserted into the armature circuit, and finally the armature connections should be reversed, leaving the shunt field circuit at all times closed upon the armature. No destructive sparking or strain upon the insulation of the motor will then occur, the supply of current is absolutely cut off from the motor, and the short circuiting of the armature through the resistance of the rheostat occurring while the field is at full strength acts as a dynamic brake, and assists to stop the motor. This method of braking a motor is easily worked out, so that the ordinary mechanical brake never sets until the motor has stopped or nearly so.

MUNICIPAL AFFAIRS

Municipal Electric Lighting.[1]—VIII.

BY PROF. JOHN R. COMMONS.

THE following table gives the comparative charges for commercial lights under public and private ownership :

TABLE X.

COMMERCIAL RATES FOR INCANDESCENT LAMPS—16 CANDLE POWER.

Municipal Plants.

	Per Month.	Lamp Hour.	Per Kw. Hr.
Braintree, Mass.		6/10c.	
Chicopee, "			11.66c.
Hingham, "			20c. yearly. 25c. summer.
Hull, "	60c.	1c. amp. hour.	
Marblehead, "		½c. y'r'ly 1c. summer.	
Middlebor'gh, "		1c.	
N. Attlebor'gh, "		¾c.	
Reading, "		¾c. 1¼c. amp. hr.	15c.
Wakefield, "	90c.	6/10c. amp. hr.	
Jamestown, N. Y.	67½ c. all night; 40c. to 10 P.M.		8c. dwellings. 10½ factories.
Lansing, Mich.	75c.		12c.
Johnson, Vt.		1/3c.	
Griffin, Ga.			12c.
Logansport, Ind.			7c.
Webster City, Ia.	(av.) 25c.		10c.
Lisbon, Ia.	40c.	½c.	
St. Charles, Ill.	50c.		15c.
Benton, Ill.	50c.		
Harrington, Kas.	75c.		
Tecumseh, Neb.	$1.25 (1st 2) 50c. (above 4)		
Savannah, Mo.	50c.		15c.
Fulda, Minn.	50c.		
Salisbury, Mo.	10 P.M. 60c; 12 P.M. 80c	1c.	20c.
Alexandria, Minn.	65c.		15c.
Waseca, Minn.			15c.
Laverne, Minn.			10c.
Wells, Minn.	50c.		10c.
Litchfield, Minn.	40c.	2/3c.	
St. Peters, Minn.	9 P.M. 50c.; 12 P.M. 65c		12½c.
Rochester, Minn.		½c.	
Marshall, Minn.		6/10c.	
Coldwater, Mich.		6/10c.	11c.
Evart, Mich.	25c.		
Hamilton, N. Y.		1¼c.	
Westfield, N. Y.	50c.	½c.	
Madison, N. J.			10c.
Hamilton, Ohio	60c.		8c.
Jackson, Ohio	60c.		10c.
Willoughby, Ohio.	(Stores) 25c.		8c.
DeGraff, Ohio	25c.-40c.	6/10c.	
Galion, Ohio	70c. to 10 lamps; 65c. to 16		10c.
Quakertown, Pa.			12c.
Schuylkill Ha'en, Pa.	25c.-65c.		
Sharpsburg, Pa.			8c.
Wytheville, Va.	25c-50c-75c all night		
Salem, Va.	40c.-65c.		20c.
Rice Lake, Wis.	50c.		20c.

Private Plants.

	Per Month.	Lamp Hour.	Per Kw. Hr.
Abington, Mass.		9/10c.	20c.
Adams, "	6 nights. Per wk. $1.00.	1c. amp. hr.	20c.
Amesbury, "	90c.		
Amherst, "			20c.
Andover, "			24c.
Athol, "			20c.
Attleborough, Mass.	90c.		20c.
Beverly, "	1.16 2/3 for 7 nights. 1.00 for 6 nights.		20c.
Block Plant, "			16 2/3c.
Blue Hill, "	$30 pr. yr.	1c.	
Boston, "		1c.	20c.
Bridgewater, "		1c.	20c.
Lansing. Prior to 1888	75c. to 9 P.M. 1.00 to 12 P.M.		
Syracuse, N. Y.			10c.
Little Rock, Ark.		1c.	
Colorado Sp., Col.		1c.	
Leadville, Col.	$1.	1¼c.	
Logansport, Ind.		1c.	
San Jose, Cal.		1¼c.	
Baton Rouge, La.	50c.		
Marseilles, Ill.	40c.		
Chicago, Ill.		1c.	
Wichita, Kas.		1c.	
Topeka, Kas.		1c.	
St. Louis, Mo.		1-1¼c.	
Duluth, Minn.		1c.	
Springfield, Mo.		1c.	
Bath, Me.		1c.	
Birmingham, Conn.			20c.
Omaha, Neb.			20c.
Binghamton, N. Y.		1c.	
N. Y. City, N. Y.		1c.	
Brooklyn, N. Y.		1c.	
Cincinnati, O.		¾c.	15c.
Mt. Holly, N. J.		½c.	
N. Brunswick, N. J.		8/10	16c.
Washington, D. C.			18c.
Philadelphia, Pa.		¾c.	18c.
Harrisburg, Pa.			18c.
Wilmington, Del.	10c. not over 1 hr., $1 lamp; 60-80c. for 3 or more.	6/10c.	

The figures for Massachusetts are taken from the Report of the Gas and Electric Light Commissioners. Those for cities outside Massachusetts are from reports made to me or to the South Norwalk Investigating Committee, or they have been collated by Mr. Parsons, in the "Arena," August, 1895.

A comparison of these rates shows that private companies charge for commercial lighting fifty to one hundred per cent. more than municipal plants. The lowest meter rate charged by private companies is in Syracuse—ten cents per kw.—whereas the usual rate is twenty cents per kw., or its equivalent, one cent per meter hour. The lowest rate charged by cities is three-tenths of a cent per lamp hour in Newark, Delaware, but the usual rate is one-half cent per meter hour, and seven to ten cents per kw.; and thirty-five to fifty cents per month against seventy-five to one dollar and twenty-five cents per month with private companies.

TABLE XI.

NET COST OF PUBLIC LIGHTING PER K. W. TO CITIES HAVING COMMERCIAL PLANT.—FOSTER.

City.	Cost per k. w. for total output.	Net cost per k. w. used by city after deducting commercial lighting.	Cost to cities by private companies.
Santa Cruz, Cal.	$0.2473	$0.2620	$0.115
Portland, Ore.	.0960	.0913	.077
S. Norwalk, Conn.	.0528	.0019	.081
Frederick, Md.	.0569	.0565	.053
Metropolis, Ill.	.1324	.1770	.091
Council Grove, Kan.	.0884	.0259	.082
Arlington, Minn.	.0975	.0149	.046
Crawfordsville, Ind.	.0758	.0830	.078
St. Clairsville, O.	.1540	.2160	.104
Little Rock, Ark.	.0561	.0011	.041
High Point, N. C.	.1470	.1760	.065
Marshalltown, Ia.	.0483	.0617	.080
Alameda, Cal.	.0565	.0734	.123
Ashtabula, O.	.1095	.1870	.162
Blue Island, Ill.	.0956	.1294	.095
Averages	.1009	.1105	.086
Same in lamp hours, 2,000 c. p. 480 watts	.0484	.0579	.041
Total cost per lamp hour, 2,000 c. p. for street plants alone...	.0444	....	....

That municipal rates are much lower than private rates is beyond question. Mr. Francisco cannot disprove it either by screwing the figures or inflating depreciation. He therefore complains that the taxpayers are being oppressed for the benefit of the consumers; and Mr. Foster gives a table showing that where the city does commercial lighting, the net cost to the city for its street lights is greater than where it does street lighting alone, which is explained, he says, by the extremely low prices for commercial work. The table is reproduced herewith.

I will show below how this table is compiled and of how little value it is. Suffice it here to say that the cities doing commercial lighting very generally report that their street lights cost them, net, much less on account of the commerical profits than they did without the latter.

PROFITS VS. REDUCED COST.

In the operation of a commercial plant it is a question of policy whether the city shall make a profit and so reduce the cost of street lighting to the taxpayers, thus taxing consumers for the benefit of taxpayers, or shall furnish the light to consumers below cost, thus taxing the taxpayers for the benefit of consumers. I assume that the nearest approach to justice is attained when each service pays its own way. Consumers should pay for what they get at its net cost price, and taxpayers should pay for street lamps at their cost. If this principle be adopted, depreciation should be charged under the operating expenses of the plant, and should be actually written off from the capital from year to year; the taxable property of the city should be assessed a fixed rate per lamp for all street lamps, the proceeds of which should be debited by the electrical administration as regular income along with the commercial income, and from the two together should be deducted operating expenses, leaving a "profit and loss" or "net revenue" account, which in turn should be credited with interest on bonds, depreciation and sinking fund.[1]

Our cities are justly charged with inferior and loose business methods, and nowhere is reform more needed than in the bookkeeping. Fair-minded opponents agree that the city has the advantage in operation of industry, especially in the low rate of

[1] Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec Engr.

[1] An admirable example of this method of municipal bookkeeping may be found in the electric light accounts of the City of Aberdeen, Scotland. Upon consultation, one will find that the city is charged for 14 lamps, consuming 11,057 k. w., £209 8s. 5d., which is a rate of 9.1 cents per k. w. for public lighting, while private consumers are charged 10 cents (5d.) per k. w. It will also be seen that the depreciation is charged at 5 per cent. on machinery and meters, 2½ per cent. on electrical instruments, 1⅓ per cent. on mains, and 1 per cent. on buildings, making an aggregate for the year 1896 of £844 19s. 7d., or a total rate on the entire expenditure at the beginning of the year of 2.7 per cent. Furthermore, by examining the "state of capital account" from 1894 to 1896, it will be seen that at the balancing of each year's accounts new construction is added and depreciation written off, so that the net balance at the close of 1896 is £34,780 5s. 5d., instead of £36,620 15s. 9d., the aggregate expenditure.

interest which it pays on loans, and the strength of their argument lies solely in attacking the looseness of methods and the incompetency, not to say corruption, of officials. Admitting that their attack is in most cases justified, the advocate of city ownership must point the way to a remedy or abandon his cause. The first step is better methods of municipal bookkeeping. It becomes especially urgent, when the city enters upon the field of commercial lighting, and it becomes important to apportion properly the expenditures between taxpayers and consumers. This urgency increases with the size of the city, where consumers outnumber taxpayers. We may conclude that as far as bookkeeping itself is concerned, a depreciation of three per cent. on the total cost of the plant is ample to cover costs, and on this basis the rates to consumers should be fixed. Three per cent. on the entire capital, compounded at four per cent.—the rate of interest paid by cities—would replace the principal every twenty-one years. This rate is amply justified, not only by the Aberdeen accounts, but also by the figures of other European cities. Glasgow, without carrying insurance, wrote off depreciation in 1894 of three and seven-tenths per cent.; in 1895 of three and nine-tenths per cent.; in 1896 of four and eight-tenths per cent.; Dublin, in 1897, nine-tenths of one per cent.; Bradford, 1897, two per cent.; Manchester, 1897, wrote off a depreciation of £5,000, equal to one and six-tenths per cent. on the capital of £309,190, but from this amount deducted repairs and renewals of £1,692 19s. 8d., leaving a net depreciation of £3,307 0s. 4d., equal to one and one-tenth per cent. The strong conservatism of these English cities makes it quite certain that they have placed depreciation at the highest rate justifiable.

ELECTRIC TRANSPORTATION

Brown Electric System on the Capital Railway Co's Lines.

THE Capital Railway Company, of Washington, D. C., which operates cars between the U. S. Navy Yard and suburbs known as Congress Heights, has the "Brown" surface contact system installed for a very short distance, between the Navy Yard and the Annacostia Bridge. Lately some trouble has arisen between the company and the District Commissioners over the methods used by the company on this short stretch of experimental road; the system on crossing the bridge being the overhead trolley. The "Brown" system is as follows: Every eight feet an iron surface contact plate projects above the ground between the rails, shown in Figs. 1 and 2. Under this plate is a hard burned material carrying a porcelain cup partly filled with mercury upon which a steel ball floats. The cars carry electro-magnets excited by storage batteries which attract the steel balls on passing over them and close the circuit under the car. These porcelain cups break by the jumping up of the balls and allow a current to flow between the surface contact plates and the rails, see Fig. 2, which is objected to by the commissioners. The commissioners have allowed ninety days to perfect

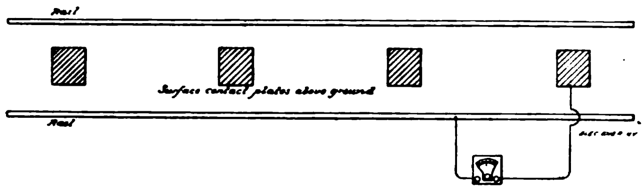


FIG. 2.—"BROWN" SURFACE CONTACT SYSTEM.
(When mercury cups break a d. of p. exists between rail and surface contact.)

these cups and stop the leak, which is very small but objectionable. When the cups are perfected and the "Brown" system is demonstrated in the district, the commissioners intend to insist on the equipment of the road with a metallic return, because of electrolysis. In addition to these exactions by the commissioners, the contact plates must be moved from the centre of the track,

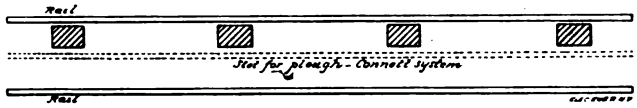


FIG. 3.—NEW POSITION OF SURFACE CONTACT PLATES IN ORDER THAT A SLOT AND CONNETT SYSTEM MAY BE INSTALLED IN ADDITION.

to one side, in order that the "Connett" slot system may be installed in addition, as shown in Fig. 3. This is done in order that other cars may run on the same track, the commissioners not allowing two sets of track on any one street.

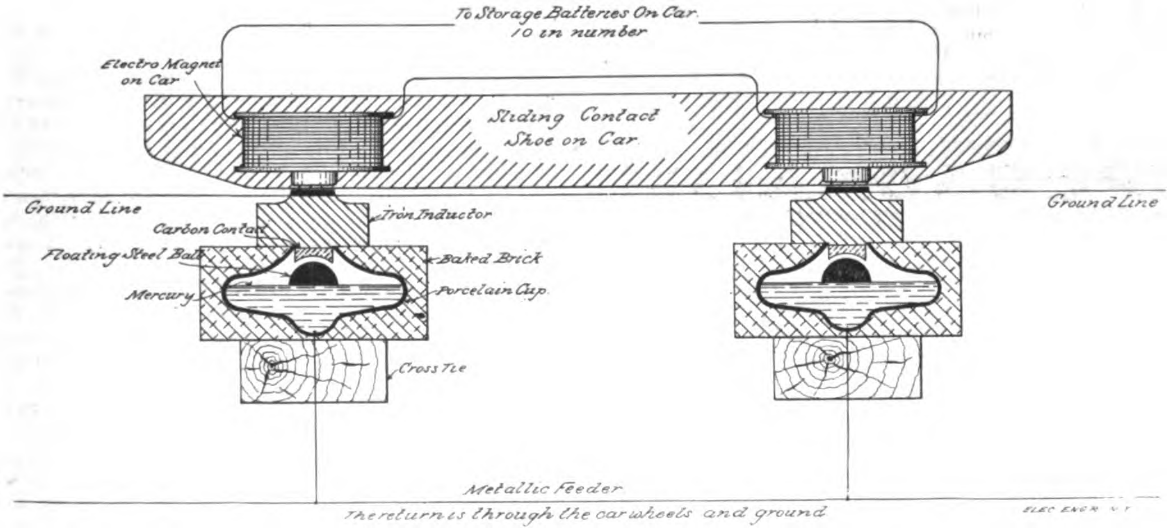


FIG. 1.—"BROWN" SURFACE CONTACT RAILWAY SYSTEM; SECTION THROUGH SHOE AND CONTACT PLATES.

will be established. This system will be equipped with electricity. The contract embracing these changes has been signed for a term of fifty years.

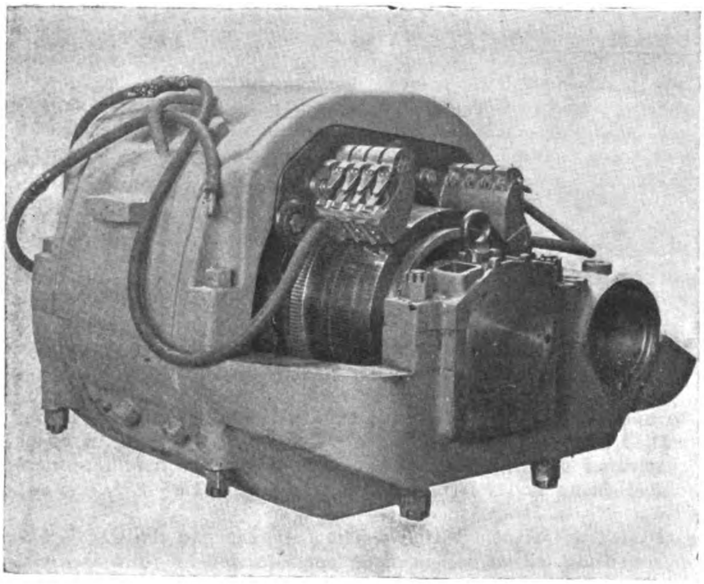
PORT HURON, MICH.—The City Electric Railway is experimenting with a ball bearing truck devised by John Deloyia, of that town.

BROOKLYN.—An arrangement has been made between the Long Island Railroad and the Brooklyn Elevated Railroad by which through trains will ultimately be run from the New York entrance of Brooklyn Bridge, without change of cars, to Jamaica, to Rockaway Beach, and to Coney Island. These destinations can also be reached via the Broadway ferry and the Broadway line of the Brooklyn Elevated by connections which will be established. This system will be equipped with electricity. The contract embracing these changes has been signed for a term of fifty years.

M. SOULECROUP, assistant superintendent of motive power of the Paris and New Orleans Railroad, has been in this country with a corps of five experts studying electrical methods. He has recently been inspecting the work in the B. & O. tunnel at Baltimore.

Walker Elevated Railway Motor.

THE Walker Company has recently placed on the market a very powerful elevated railway motor, an illustration of which is shown below. Power considered, this motor is a marvel of lightness and compact construction. Two such motors may be installed on an ordinary standard gauge 33-inch wheel, 6-foot wheel base bogie truck, thus making it easily possible to equip a car with from 600 to 700 horse power. Such a car can do tractive work that will compare favorably with the ordinary passenger locomotive. This motor was designed for elevated work, and has given great satisfaction in such service, and it will operate equally well over a clean stone ballasted interurban line. Being, however, of open construction, it is not suited for work



WALKER ELEVATED RAILWAY MOTOR.

on street car lines, where mud and dust demand greater protection. The Metropolitan West Side Elevated Road in Chicago is being equipped with these motors, which are known as the Walker 20 L., while a smaller size of the same type known as the 15 L. is being built for the equipment of the Brooklyn L.

Among other roads using the heavy Walker motors may be mentioned: The Rapid Railway, of Detroit; the Sutro Railway, San Francisco; the Suburban Railway, Chicago; the Anaconda Electric Railway, Anaconda, Mont.; and the East St. Louis and Belleville (now building), besides many others.

PERSONAL

Mr. Charles A. Boyd.

Mr. Chas. A. Boyd, Superintendent of the Walker Company of Cleveland, has resigned his position, to take effect April 12. He will enter business for himself, doing general engineering, with offices in the American Trust Building, Cleveland, Ohio. Mr. Boyd has been with the Walker Company for the past four years, starting as engineer in the railway motor department, having charge of the design and construction. About one year later he was placed in charge of the entire engineering department, and was promoted to the position of assistant superintendent on January 1, 1897. The following March he was appointed superintendent of the Cleveland works, having in charge both the engineering department and shops.

MESSRS. SELLON and HODGKIN, of the Brush Engineering Co., of England, sailed for home last Saturday.

MR. C. F. HUTCHIGS, formerly superintendent of the Wilmington, Del., City Railway Co., has been appointed superintendent engineer by the United Alkali Co., of Bay City, Mich., and has entered upon his new duties.

MR. LUTHER STIERINGER, the consulting electrical engineer of the Omaha Exposition, has returned to New York for a brief stay to attend to pressing personal matters and arrange for some important details in regard to leading exhibits there.

NEWS AND NOTES

How the Spaniards Blew Up the Maine.

Mr. J. P. Gibbins, in a signed communication to the New York "World," from London, dated April 7, states that he supplied the Spanish Government with 56 ground mines and 25 buoyant mines, each charged with 500 pounds of guncotton; and 15 electro contact mines, each charged with 100 pounds of guncotton. There was also a latter order. Mr. Gibbins asserts that he himself shipped some of these mines to Havana, from the West India Dock, London, on a Spanish Government vessel. He expresses his belief, with reason therefor, that the "Maine" was blown up by a mine operated by Spanish officers, who alone could have control and knowledge of the apparatus, and adds: "I have not the slightest hesitation in saying that the 'Maine' was deliberately destroyed with a 500-pound ground mine, as invented and supplied by me." Mr. Gibbins enters into the precautions necessarily taken in firing such electrical mines, and shows how their very complication is intended to avoid all possibility of accident or meddling.

It is understood that evidence is being adduced showing the connection of the electric lighting system of Havana into the circuits running to the mines, for the purpose of furnishing the required current quickly.

Preparations for War.

Frank J. Sprague, Vice-President of the Sprague Electric Company, is organizing an emergency corps of electricians and electrical engineers to work in conjunction with the State Naval Reserve in the event of hostilities. Mr. Sprague is a graduate of the Annapolis Naval Academy. He has communicated his plan to the Assistant Secretary of the Navy and says it has received Mr. Roosevelt's indorsement and that of Captain Jacob W. Miller, Commander of the Naval Reserve of New York. Mr. Sprague invites electricians and engineers who want to join the proposed auxiliary corps to write to Room 1511, Commercial Cable Building, stating age, address, and place of employment. Unmarried men are preferred.

As already announced in these columns, Captain Eugene Griffin, late U. S. A., first vice-president of the General Electric Co., with the approval of the Secretary of War and the Chief of the Engineer Corps, Brigadier General J. M. Wilson, has undertaken the formation of a Volunteer Electrical Corps. He obtained a list of the most skilful workmen in the employ of his own company and informed each of them what he wanted and asked if they would volunteer for the service. Captain Griffin made it clear that in case of war the volunteers might be called upon to make needed repairs on warships after their service in the army was over. He also stated that, in case the Government had need of their services, they would draw their pay from the company during all the period of service, as well as pay from the Government, with the privilege of going back to their old jobs when the war was over. He then wrote to other electrical companies in this city telling them what he wanted to do and what he had done and asked them to co-operate with him. To electrical companies in Boston and Philadelphia he sent similar communications. The quickness with which the replies came was astonishing. From his own men Captain Griffin received the most loyal responses. Everybody to whom he wrote wanted to volunteer. In this vicinity Captain Griffin has received favorable replies from the United States Electrical Supply Company, from the Edison Electric Company of Brooklyn, from the Mount Morris Electric Light Company, from the Manhattan Electrical Supply Company and from the Westinghouse Company. From Boston came responses from the Edison Illuminating Company, the Marlborough Electric Light Company, from the Bell Telephone Company and the Boston Telegraph Company. A number of Philadelphia companies also

responded. The result was that in less than a week more than 1,000 men had been enrolled. Captain Griffin obtained the day and night address of every volunteer. These were sent to the office of the Chief of the Engineers' Corps at Washington, where they are now on file. In Baltimore, Dr. Louis Duncan has been doing similar active work with excellent results.

The Westinghouse Electric Mfg. Company has begun shipment to the Brooklyn Navy Yard, of large quantities of generators, motors, dynamos and wires. They are to be used for the installation of electric power and light plants on board the merchantmen, old monitors, and coasting steamers now being equipped by the Government for service in case of war with Spain. The order is for $682,000 worth of such material, and the company will receive a bonus of $25,000 for prompt delivery. Shipments will be made every day this week.

Mr. W. R. Brixey, owner of Day's Kerite, is running his factory at Seymour, Conn., night and day on Government orders for insulated wires and cables.

The Pennsylvania Electric Company of Marietta has received a large order for telephones from the War Department, to be used for all the forts, coast defence and signal stations along the Atlantic coast. The company received instructions to rush the order. This is quite a compliment to the Crescent Telephone apparatus.

The Growing List of Exhibitors for the Electrical Exhibition.

IN our issue of February 17, we published a preliminary list of exhibitors for the May Exposition. We are now able to present a revised list, for which we are indebted to the manager, Mr. Marcus Nathan. It is as follows:

Armorite Interior Conduit Co., Pittsburg, Pa.
American Rheostat Co., Milwaukee, Wis.
American Pulley Co., Philadelphia, Pa.
American Watchman's Time Detector, 234 Broadway, N. Y.
American Engine Co., Bound Brook, N. J.
Adams-Bagnall Electric Co., Cleveland, Ohio.
Armington & Sims Co., Providence, R. I.
American Electrical and Maintenance Co., 451 Greenwich Street, N. Y.
American Electrician Co., New York.
American Electrical Works, Providence, R. I.
American Electric Novelty & Manufacturing Co., 231 Broadway, N. Y.
American Circular Loom Co., Boston, Mass.
Bullock Electric Co., St. Paul Building, New York.
Bossert Electric Construction Co., Utica, N. Y.
Baylis Co., The, 99 Cedar Street, N. Y.
Borne, Scrymser Co., 80 South Street, N. Y.
Belknap Motor Co., Portland, Me.
Brewster Engineering Co., 27 Thames Street, N. Y.
Barrows & Co., C. H., 302 West 53d Street, N. Y. (Electric Vehicles.)
Broomell, Schmidt & Co., York, Pa.
Boston Electro Duct Co., Boston, Mass.
Burhorn & Granger, 136 Liberty Street, N. Y. (Woodbury Engine.)
Babcock & Wilcox Co., 29 Cortlandt Street, N. Y.
Crocker-Wheeler Electric Co., 39 Cortlandt Street, N. Y.
C & C Electric Co., 143 Liberty Street, N. Y.
Corey, R. B., 26 Cortlandt Street, N. Y.
Coho & Co., H. B., 220 Broadway, N. Y.
Card Electric Co., Mansfield, Ohio.
Camp Co., H. B., Aultman, Ohio.
Cleveland Twist Drill Co., Cleveland, Ohio.
Crouse-Tremaine Carbon Co., Fostoria, Ohio.
Crown Woven Wire Brush Co., Salem, Mass.
Cook's Sons, Adam, 313 West Street, N. Y.
Cutter Electrical & Manufacturing Co., Philadelphia, Pa.
De La Vergne Refrigerating Machine Co., 138th St. and East River, N. Y. (Hornsby-Akroyd Oil Engine.)
Diamond Electric Co., Peoria, Ill.
Diesel Motor Co. of America, 11 Broadway, N. Y.
Edison, Thomas A., Orange, N. J., per W. S. Mallory.
Edison Manufacturing Co., Orange, N. J.
Edison, Jr., Thomas A., 96 Broadway, N. Y.
Edison Electric Illuminating Co., of N. Y., Duane and Elm Streets, N. Y.
Eddy Electric Manufacturing Co., Windsor, Conn.
Electric Storage Battery Co., Philadelphia, Pa.
Excelsior Electric Co., Brooklyn, N. Y.
Electrical Engineer, New York.
Electrical Review, New York.
Electrical Age Publishing Co., New York.
Electricity Newspaper Co., New York.
Electrical World, New York.
Elliott & Hatch Book Typewriter Co., 253 Broadway, N. Y.
Electrical Engineer Institute of Correspondence Instruction, 120 Liberty Street, N. Y.
Fischer Foundry & Machine Co., Pittsburg, Pa.
Fort Wayne Elec. Corporation, Fort Wayne, Ind.
Fuel Economizer Co., Matteawan, N. Y.
Fostoria Incandescent Lamp Co., Fostoria, Ohio.
Fiberite Co., Mechanicsville, N. Y.
Fairchild & Sumner, 39 Cortlandt Street, N. Y.
Francis Bros., Philadelphia, Pa.
Gold Car Heating Co., Cliff and Frankfort Streets, N. Y.
Garton-Daniells Electric Co., Keokuk, Ia.
Garvin Machine Co., Spring and Varick Streets, N. Y.
General Incandescent Arc Light Co., 33d Street and 1st Avenue, N. Y.
Griffing Iron Co., A. A., Jersey City, N. J.
Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa.
Highland Chemical Co., Connellsville, Pa.
Haines Co., Wm. S., Philadelphia, Pa.
Haring Steam Plant Equipment Co., 26 Cortlandt St., N. Y.
Hope Electric Appliance Co., Providence, R. I.
Ideal Electric Corporation, 13th and Hudson Sts., N. Y.
Imperial Porcelain Works, Trenton, N. J.
India Rubber & Gutta Percha Insulating Company, Glenwood, N. Y.
International Arc Lamp Co., Mercer and Houston Streets, N. Y.
Jones & Son, J., 60 Cortlandt Street, N. Y.
Keuffel & Esser Co., 127 Fulton Street, N. Y.
Kelley & Sons, B. F., 91 Liberty Street, N. Y.
Keystone Elec. Inst. Co., 9th St. and Montgomery Ave., Philadelphia, Pa.
Kelley & Mueller, 7 West 13th Street, N. Y.
Kosmic Oil Filter Co., Easton, Pa.
K. & W. Company, Pittsfield, Mass.
Katzenstein & Co., L., 357 West St., N. Y.
Kensington Engine Works, Ltd., Philadelphia, Pa.
Kirkland, H. B., 120 Liberty Street, N. Y.
Lewis Tool Co., 44 Barclay Street, N. Y.
Lynn Incandescent Lamp Co., Lynn, Mass.
Morris, Elmer P., 15 Cortlandt Street, N. Y.
Machado & Roller, 203 Broadway, N. Y.
Mowrey, P. M., & Co., 318 Broadway, N. Y.
Monarch Manufacturing Co., Waterbury, Conn.
Niles Tool Works Co., Hamilton, O., and New York.
National Meter Co., 118 Chambers Street, N. Y.
Nowotny Electric Co., Cincinnati, Ohio.
National Carbon Co., Cleveland, Ohio.
Nash Gas Engine Co., 99 Cedar Street, N. Y.
New Britain Machine Co., New Britain, Conn.
N. Y. Safety Steam Power Co., 30 Cortlandt Street, N. Y.
N. Y. Car Wheel Works, Buffalo, N. Y.
N. Y. Telephone Co., 18 Cortlandt Street, N. Y.
Oswego Boiler Works, Oswego, N. Y.
Otis Electric Co., 38 Park Row, N. Y.
Onondaga Dynamo Co., Syracuse, N. Y.
Paragon Arc Lamp Co., Boston, Mass.
Peru Electric Manufacturing Co., Peru, Ind.
Peckham Motor Truck & Wheel Co., 26 Cortlandt Street, N. Y., and Kingston, N. Y.
Partrick, Carter & Wilkins, Philadelphia, Pa.
Paragon Electric Fan Motor Co., 39 Cortlandt Street, N. Y.
Porter & Remsen, 39 Cortlandt Street, N. Y.
Prindle Pump Co., 136 Liberty Street, N. Y.
Partridge Carbon Co., Sandusky, Ohio.
Pope Mfg. Co. (Motor Carriage Department), Hartford, Conn.
Platt Manufacturing Co., O. S., Bridgeport, Conn.
Roebling's Sons Co., John A., Trenton, N. J.
Riker Elec. Motor Co., 45 York St., Brooklyn, N. Y. (Electric Vehicles.)
Safety Insulated Wire & Cable Co., 229 West 28th Street, N. Y.
Stephenson Co., Ltd., John, 47 East 27th Street, N. Y.
Silex Insulation Co., 39 Cortlandt Street, N. Y.
Sprague Electric Co., 20 Broad Street, N. Y.
Simonds Manufacturing Co., Pittsburg, Pa.
Sinclair, D. J., Caledonia, N. Y.
Street Railway Journal Co., New York.
Street Railway Review, Chicago, Ill.
Shaw, H. M., 126 Liberty Street, N. Y.
Samson Cordage Works, Boston, Mass.
Translucent Fabric Co., Quincy, Mass.
Thomas & Sons Co., R., East Liverpool, Ohio.
United States Electrical Supply Co., 141 East 25th Street, N. Y.
Universal Electric Co., 126 Liberty St., N. Y.
Vacuum Oil Co., Rochester, N. Y.
Van Horne, Burger & Co., Dayton, Ohio.
Worthington, Henry R., New York.
Walker Co., Cleveland, Ohio.
Weston Electrical Instrument Co., Newark, N. J.
Warren Electric Mfg. Co., Sandusky, Ohio.
Williams & Co., J. H., Brooklyn, N. Y.
White, J. G., & Co., 29 Broadway, N. Y.
Western Electrician, Chicago and New York.
Worthington Water Tube Boiler, 30 Cortlandt Street, N. Y.
Williams, J. P., 39 Cortlandt Street, N. Y.
Warren-Medbery Co., Mechanicsville, N. Y.
Wilday, J. H., 23 Duane Street, N. Y.
Warren Electric & Specialty Co., Warren, Ohio.
Zindars & Hunt, 127 Fifth Avenue, N. Y.
Ziegler & Co., Boston, Mass.

Instruments of Precision at the Exhibition.

The Brooklyn Polytechnic Institute, and Dr. Samuel Sheldon, its Professor of Physics and Electrical Engineering, have kindly loaned the Electrical Exhibition several interesting units and standards upon which precision in electrical measurements is based. Even the electric public, while it hears a great deal of such standards, rarely sees them, and this exhibit, therefore, will be at once of technical and popular interest. The exhibit will include especially some standards from the German Imperial Physico-Technical Institute (Reichsanstalt), whose celebrated work has been done under the guidance of such men as Helmholtz and Kohlrausch; and it is probable that these standards have never before been exhibited in public in this country. Dr. Sheldon will show the Reichsanstalt form of the standard Clark cell, the Reichsanstalt pattern of photometer with Hefner amyl-acetate standard lamp, and Lummer Brodhun contrast screen; standard .01 ohm for carrying heavy currents; large standard compensation set for the precise comparison of voltages from

.01 to 1,200 volts and currents of any magnitude; standard Wheatstone bridge; Thomson's double bridge for conductivity measurements; standard Carhart-Clark cell, etc. The exhibition of such apparatus, and the explanation given as to its use will do much to bring electrical measurements within the comprehension of the public, and to demonstrate the wonderful refinement of accuracy that modern electricians aim at in their apparatus.

Stationary Engineers at the Exhibition.

Arrangements have been made through Mr. W. T. Wheeler, Vice-Pres. Nat. Assn., and member of the Exhibition Auxiliary Committee, for the meetings of about fifty associations of the N. A. S. E. These associations will come from New York, New Jersey, Pennsylvania, Massachusetts, Rhode Island and Connecticut. Several rooms suitable for meetings have been provided and the various lodges invited almost without exception have accepted the invitation and will hold their regular meeting nights as the guests of the Exhibition Company. It is expected that there will be an attendance of at least 5,000 practical engineers (two lodges every evening), and the exhibition management is arranging a registry system with bulletin boards in different sections of the building, so that exhibitors may know just what associations of engineers are present and the plants with which they are connected.

Sprague Electric Co's. Exhibit.

The Sprague Electric Company have reserved sufficient space for a very comprehensive exhibit of their product at the Electrical Exposition. The exhibit will comprise a type of each Sprague electric elevator manufactured by that concern; a direct connected lighting plant; Lundell power and fan motors; exhaust fan outfits; a printing machine in operation, together with blowing outfit; a cab of the London type with automobile motor and Sprague controller; screw pumps; armatures; conduit; switchboards and conduit racks. The Sprague Company promises to make as complete an exhibit as has ever been made in their particular line.

LEGAL NOTES

Decision by U. S. Circuit Court of Appeals Against Under-Running Trolley Patent.

UNITED STATES CIRCUIT COURT OF APPEALS. SECOND CIRCUIT. THOMSON-HOUSTON ELECTRIC COMPANY, Appellee, vs. UNION RAILWAY COMPANY, et al, Appellants.

PER CURIAM.—This appeal involves the question whether Claims 2 and 4 of Letters Patent No. 495,443 for "traveling contact for electric railways," granted April 11, 1893, to the administrators of Charles A. Vandepoele, assignors to the complainant, are void because they are for the same inventions which had been previously patented in Letters Patent No. 424,695. The invention, to adopt the language of an expert witness for the complainant in a former suit brought upon the patent, "consists generally in an electric railway, having an overhead conductor, and a car for said railway provided with a contact device carried by the car so as to form a unitary structure therewith, and consisting of a trailing arm hinged and pivoted to the car so as to bridge the space between it and the conductor, and move freely both laterally and vertically, and said arm carrying at its outer end a contact device capable of being pressed upward by a suitable tension device into engagement with the under side of the conductor." The essential features of construction involve the location of the supply conductor above the track and line of travel of the car and contact with its under side; the arrangement of the contact device on a trailing arm; and the maintenance of a constant upward pressure by means of a tension device operating upon a hinged arm. The two claims in controversy are:

2. "The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor, and an arm carried by the car and carrying the contact device, and pivoted so as to swing freely around a vertical axis."

4. "The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor, and an arm on the car movable on both a vertical and a transverse axis and carrying the contact device."

The patent contains sixteen claims. The characteristics of the invention and the scope and validity of many of the claims were considered by this court in Thomson-Houston Electric Company vs. Hoosick Railway Company (82 Fed. Rep., 461), where we held that Claims 6, 7, 8, 12 and 16 were for the same inventions which had been previously patented; and a reference to the opinion in that case will dispense with the necessity for any extended discussion now. Referring to some of those claims we said: "It would be a waste of time to dwell upon the verbal differences in these claims. The changes in phraseology import nothing of substance into their respective combinations. They describe the same thing in different language." It is insisted for the appellants that the two claims now in controversy are for the same combinations specified in some of the claims which were then held to be void. The appellee contends that they are not because they omit to specify any means for holding the contact device in underneath contact with a conductor, and consequently can be construed as covering a sub-combination in which such means are not employed, or if such means must be read into the claims by implication the claims are not limited to the means described in the specification, and that upon either construction they are not the claims of the earlier patent. The court below adopted this view. If the appellants are right no other question need be considered. It will be seen that these claims are for identical combinations except that the arm is differentiated in each by functional characteristics. The specification describes a traveling arm carried by a post on top of the car "which is hinged and should in most instances be also pivoted to the top of the post, although a reasonable amount of looseness in the hinged joint will answer the purpose of the pivot." When pivoted "it swings freely around a vertical axis," and meets the terms of Claim 2. When hinged and loosely jointed, it is "movable on both a vertical and transverse axis," and meets the terms of Claim 4. We do not entertain any doubt that there must be incorporated into these claims, by implication, means for maintaining the contact device and the conductor in their normal working relations. Without them there is really no "traveling" contact device, and no operative combination; and the claims would cover merely an aggregation of devices which do not co-act unless assisted by some instrumentality which must be discovered and supplied. The function of the arm as constructed and arranged is to establish "moving contact" while maintaining a positive mechanical connection between the vehicle and the conductor. It was devised because as previously mounted the contact was found to be deficient in compacity to follow the sinuosities and deflections of the conductor while the car was in motion. It can only perform this function by the aid of some instrumentality which holds it constantly in the proper relations to bridge the space between the car and the conductor and keep the contact device and the conductor in electrical connection. As pointed out in the specification, this consists of a tension device operating upon the arm and maintaining a constant upward pressure, thus holding the contact device to the conductor. This tension device, or its equivalent, is an indispensable element of the respective combinations.

That the proper construction of the claims is as thus indicated is evidenced upon the proceedings upon interference in the Patent Office. Claim 2 is a literal statement of the issue defined and formulated by the Patent Office between what was then Claim 1 of the application and the claims of two interfering applications. Claims 1 was as follows: "In an electric railway, the combination with a suitable contact and the supply conductor suspended above the track, of a car provided with a swinging arm carrying a contact device in its outer extremity and means for imparting upward pressure to the outer portion of the arm and contact, to hold the latter in continuous working relation with the under side of the supply conductor substantially as described." In formulating the issue the office omitted as unnecessary, because necessarily implied, the elements enumerated in Claim 1 of the application which are not enumerated in Claim 2 of the patent. One of these elements was "means for imparting upward pressure to the outer portion of the arm and contact." This element was apparently thought to be as indispensable to the operativeness of the combination of the claim as was "a suitable track," an element also omitted.

The appellee concedes that the claims are for combinations specified in other claims of the patent, which by our former decision were held to be void, if they require the construction

which we have placed upon them. Indeed Claim 6, which we held to be void, is identical in terms with Claim 1 of the interference proceedings, the claim which the Patent Office regarded as embodying the invention covered by present Claim 2. The rule of construction which usually obtains whereby several claims of a patent are to be differentiated, so that effect may be given each, can not be reasonably invoked in behalf of this patent where so many of the claims are duplicated.

The order granting a preliminary injunction is reversed.

Judges Wallace and Shipman constituted the court.

The counsel who argued the case were:

For Walker Co.

Charles E. Mitchell, of Mitchell, Bartlett & Brownell, and Wm. Houston Kenyon, of Witter & Kenyon.

For General Electric Co.

F. H. Betts, of Betts, Sheffield & Betts, and F. P. Fish.

Telephone Switchboards.

United States Judge de Haven sitting in the United States Circuit Court has decided that the Western Electric Company is entitled to an injunction restraining the Capital Telephone and Telegraph Company from the use of the Perrin multiple switchboard. The court also ordered an accounting. The switchboard used by the defendant was invented by Thomas J. Perrin and was patented in April, 1885. The court found that Leroy B. Firman had reduced his invention of a multiple switchboard to practice early in 1879 and several months earlier than the other patent.—San Francisco Call.

SOCIETY & CLUB NOTES

Canadian Electrical Association.

A well attended meeting of the Executive Committee of the above association was held at the office of the secretary, Mr. C. H. Mortimer, Confederation Life Building, Toronto, on the 5th inst., to further arrangements for the annual convention which is to be held in Montreal.

The dates chosen for the convention are Tuesday, Wednesday and Thursday, the 28th, 29th and 30th of June. The headquarters of the association during the convention will be at the Windsor Hotel, where the business sessions and the annual banquet will also be held.

The draft programme recommended by the local committee of arrangements, with some slight amendments, was adopted, and is as follows:

First Day.—Executive meeting 9.30 to 10 a. m.; session, 10 a. m. to 1 p. m.; session, 2 to 5 p. m.; 7.30 p. m.; trip around Mount Royal by special Park and Island cars, afterwards ascending Incline railway to lookout on mountain to view the city under illumination.

Second Day.—Session, 9 to 12, noon; cabs and busses from Windsor Hotel at 1 p. m. to visit; (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Co., returning to city at 7.30 p. m.; 9 p. m., annual banquet of Association at Windsor Hotel.

Third Day.—Session, 9 to 12 a. m., election of officers and visit to McGill University; 1.30 p. m., visit to Royal Electric Company's lighting station and factory, then by special G. T. train to visit the work of the Chambly Manufacturing Company at Chambly.

A number of very interesting and instructive papers relating to various phases of electrical work have been promised, and are in course of preparation.

Negotiations are in progress with the object of securing special transportation rates to enable a large number of the Western members to participate in the proceedings of what will undoubtedly be a very pleasurable and instructive occasion.

THE COLUMBIA UNIVERSITY TEA on Saturday, April 16, will take place in the Physics and Engineering Buildings, from three until six p. m.

New Members of the New York Electrical Society.

Secretary G. H. Guy reports the following list of over fifty new members elected March 30: W. C. Broadhurst, H. M. Lamont, C. Morris Haskell, Edwin H. Daly, Gustavo Lobo, Richard Lamb, J. B. Taltavall, Fred Catlin, Clarence W. Phillips, Marcus Nathan, Harris I. Goldstein, A. L. Saruya, Joseph Miller, Henry C. Mortimer, Earle Ovington, Dr. C. A. Doremus, Geo. F. Porter, A. L. Doremus, Morton Webster Haddock, Richard Koch, H. A. Strauss, F. H. Hawkins, Conrad Wachter, Elmer P. Morris, John Maguire, John Joyce, Jens Skougaard, E. Y. Porter, C. D. Warner, S. Glover Way, Harold Briesen, Christopher M. Lowther, W. J. Clarke, R. E. Gallaher, E. N. Stevenson, Theodore B. Entz, W. H. Palmer, Wm. F. Crawford, C. N. Wheeler, C. W. MacMullen, C. M. Clark, Jos. C. Youenes, Calvin Winsor Rice, L. B. Pearson, Fenton S. Grant, Philip Menges, D. L. Collins, Louis S. Levy, Samuel F. Butterworth, J. J. Bellman, Geo. Sanders Weston, 2d.

NEW YORK ACADEMY OF SCIENCES will hold, in the American Museum of Natural History, its fifth annual reception, with exhibition of the recent progress of science. The days are April 13 and 14.

THE STOCK MARKET

The Strain of Waiting.

Just when this wretched Cuban business is to get into some definite shape, nobody knows at this time of writing, but most people hope it will be ended by ending it. Trade has become quiet where it was brisk and buoyant, and though general business continues excellent, it has a hesitating tone, due to the expectancy of war with all its uncertainties. It is a curious note of the times that bicycle sales in New York and Chicago are said to be the largest on record for the season in any year. The present demand for insulated wires and cables, due in part to Government orders, is also said to be without precedent.

During the week, 8,468 shares of Western Union were sold at higher prices, closing at 86¼, a net gain for the week of 1½. Of General Electric, 5,775 shares were sold, around 32½. New York Edison sold as low as 119, possibly on account of the new issue of stock for extensions. In Boston, American Bell Telephone sold off 4 points to 247.

DR. ELISHA GRAY contributes an article to the "Chicago Herald" on electricity in harbor and coast defense.

DETROIT, MICH. A suit has been brought against the Detroit Telephone Co., etc., for $400,000, for damages, by W. R. Cole, of Mt. Clemens, who claims that his patents have been infringed and his ideas stolen.

PONTIAC, ILL. The Livingston County Telephone Co., J. A. Smith, president; W. E. E. Herron, secretary and general manager, incorporated last February, and equipped with a Stromberg-Carlson system of 500 drops, now has 200 subscribers. It is to build two or three exchanges of about 100 miles toll line each.

CITIZENS' TELEPHONE CO. proposes to operate in New York and New Jersey, under the Martin-Cole duplex system, similar to that in use in Detroit. Mr. D. A. Reynolds represents the company. The rates mentioned are $100 for unlimited service in New York, and $75 for Brooklyn; with a rate of $50 for 500 calls, for "limited service."

PROPOSED CABLE TO HONOLULU. A bill has been introduced in the Hawaiian Senate to authorize the construction of a cable by the Pacific Cable Company, known as the H. Scrymser & Co., whose bill in Congress was favorably reported on by a committee of the House several weeks ago. The bill gives an exclusive cable right to the islands for twenty years. A guarantee of $25,000 in Government bonds is to be put up by the company.

INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents Issued March 29, 1898.

Alarms and Signals:—

ELECTRIC RAILWAY SIGNALING SYSTEM. B. Samuels, St. Joseph, Mo., 601,482. Filed May 6, 1896. Block system. Details of construction.

Batteries, Secondary:—

STORAGE BATTERY. C. S. Kaufmann, Chicago, Ill., 601,471. Filed Sept. 4, 1897. Comprises plates having insulating supports arranged between them provided with T-shaped lower ends and a longitudinal channel, and pins projecting from the faces of some of the plates with their ends received into the channels in the insulating supports.

Conductors, Conduits and Insulators:—

WIRE HOLDER. F. Canfield, Boulder, Colo., 601,412. Filed Oct. 23, 1897. Consists of the combination of a link composed of vulcanized fiber, a saddle of rubber having jaws for embracing the conductor, and a key for clamping the conductor within the saddle.

CLAMPING BUCKLE FOR ELECTRIC LINE WIRES. A. H. Weikman, Palmyra, N. J., 601,454. Filed Dec. 8, 1897. Comprises an elastic fulcrum wire adapted to embrace the insulator and having open projecting ends combined with a pivotally connected lever, and a clamping bail adapted to bend the line wire, and bind the line wire to the insulator.

MEANS FOR SUPPORTING ELECTRIC WIRES. B. D. Smock, Wickatunk, N. J., 601,357. Filed February 10, 1897. Comprises a support carrying two parallel bars to which are fastened line supports, consisting of hooks carried with insulating material.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. W. L. Bliss, Brooklyn, N. Y., 601,233. Filed Oct. 14, 1897. Consists in demagnetizing the field of the dynamo, as its speed and e. m. f. increase, by means of an auxiliary counter e. m. f., which increases as the speed and electromotive force of the dynamo increase and which is connected in series with the primary exciting field coil of the dynamo.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. P. F. Krug, New York, 601,268. Filed Jan. 7, 1897. Comprises a supporting stand, a supporting arm provided with a movable fulcrum bearing against the stand, carbon holders and means for supporting and adjusting them, and means for setting and adjusting the supporting arm and its fulcrum.

Measurements:—

MAXIMUM METER. A. H. Hoyt, Penacook, N. H., 601,256. Filed July 29, 1897. A thermal registering maximum meter embodying two strips of thin metal covering opposite sides of the heating area of the thermal tube and electrically connected in parallel, and similarly connected to the stationary and movable parts of the instrument.

Miscellaneous:—

ELECTRIC LIGHTER FOR GAS BURNERS. L. V. Lewitzki, Brussels, Belgium, 601,351. Filed April 15, 1897. Adapted for use on Welsbach burners. Details of construction.

METHOD OF AND APPARATUS FOR PRODUCING CALCIUM CARBID. C. L. Wilson, C. Muma, J. W. Unger, H. Schneckloth, A. P. Brosius and J. C. Kuchel, Holstein, Ia., 601,366. Filed Feb. 13, 1897. Comprises a furnace having a lining of calcium carbid loosely arranged within the furnace wall, means for establishing an electric arc within the furnace and means for feeding lime and carbon into the arc.

ELECTRIC FURNACE FOR MANUFACTURING CALCIUM CARBID. C. L. Wilson, C. Muma, J. W. Unger, H. Schneckloth, A. P. Brosius and J. C. Kuchel, Holstein, Ia., 601,367. Filed Feb. 13, 1897. Consists in the construction of a hollow electrode having at its upper end an insulator provided with openings to communicate with the openings of the electrode and means for raising and lowering the electrode and insulator jointly, so that the operator may by hand feed sticks of lime and carbon into the arc between the electrodes.

CATAPHORIC-ELECTRODE SUPPORT. M. W. Hollingsworth, Philadelphia, Pa., 601,396. Filed Nov. 24, 1897. Comprises an interdental clamp, means for operating the clamp and an electrode holder adjustably connected to the means.

ELECTRIC HEATER. J. F. McElroy, Albany, N. Y., 601,585. Filed Feb. 14, 1895. Comprises supporting brackets carrying a spindle, a core of insulating material having a square perforation adapted to be placed on the spindle, a coiled resistance on the insulating material, and means for holding the same in position.

REGULATOR FOR ORGANS HAVING ELECTRICAL AIR PUMPS. L. K. Fuller, Brattleborough, Vt., 601,318. Filed July 20, 1895. Employs an electric motor for operating the air pump, in combination with a regulator for regulating the volumetric capacity of the air passage between the air chamber and the mouth of the wind-conductor, and means controlled by the organist for governing the regulator.

Railways and Appliances:—

COMBINED RAIL JOINT AND BOND. H. R. Keithley, New York, 601,263. Filed Jan. 3, 1898. Comprises a single metallic piece forged around the meeting ends of two rails, and a bonding plate interposed between the rails and joining piece.

ELECTRIC RAIL BOND. F. W. Atkinson, Chicago, Ill., 601,458. Filed Oct. 4, 1897. Consists of two or more strips of wires which are bent together into two angles to approximately the form of the letter Z, and terminally held together in the same plane by securing-rivets.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRIC SWITCH. O. S. Platt, Bridgeport, Conn., 601,276. Filed Feb. 2, 1897. Flush push-button switch. Details of construction.

FUSIBLE CUT-OUT. F. Schwedtmann, St. Louis, Mo., 601,286. Filed May 6, 1897. Consists in a fusible cut-out of porcelain, having the fuse surrounded by some material which will not be injured by the burning out of the fuse.

SAFETY DEVICE FOR ELECTRIC ELEVATORS. J. D. Ihlder, New York, 601,301. Filed Oct. 15, 1896. Combines with the car and motor a potential switch arranged in the circuit of the motor, and a shunt circuit including the magnet of the safety brake device.

AUTOMATIC CUT-OUT. H. F. Blackwell, Jr., Brooklyn, N. Y., 601,492. Filed Aug. 28, 1897. Comprises a spring-actuated arm forming a conductor, a link connected at one end to the arm and at the other end to a part insulated from the arm and a carbon point in the circuit and engaging with the link and adapted to separate the link when heated by an excessive current.

RHEOSTAT. P. E. Pool, Quincy, Ill., 601,588. Filed Jan. 31, 1898. Designed for use in connection with reversible motors for elevator service.

Classified Digest of U. S. Electrical Patents Issued April 5, 1898.

Alarms and Signals:—

HEAT DETECTOR FOR ELECTRIC FIRE ALARM SYSTEMS. J. E. Gould, Brooklyn, N. Y., 601,730. Filed January 30, 1896. Described in detail in issue of January 6, 1898.

Batteries, Primary:—

ELECTRIC LANTERN. O. C. Prasse, West New Brighton, N. Y., 601,758. Filed June 28, 1897. Adapted for bicycle use and comprises a casing having a removable head thereon and a depending cylindrical carbon attached to the head, an inclosed porous cup and a removable zinc contained within the cup, the cup and the said casing adapted for respectively containing chemical compounds, the head having a diagonal vent containing mercury leading there through for the escape of gases.

Conductors, Conduits and Insulators:—

MACHINE FOR RESTORING INSULATED WIRE. N. Wilson, Portland, Ore., 601,694. Filed August 20, 1897. Comprises a straightening device for straightening the old insulated wire, and a stripping device in advance of the straightening device for removing the insulation from the wire.

Lamps and Appurtenances:—

ADJUSTABLE HANGER FOR INCANDESCENT LIGHTS. F. C. Bell, Coeur d'Alene, Idaho, 601,930. Filed March 26, 1895. Details of construction.

Miscellaneous:—

BOWLING ALLEY. E. Brooks, Milton, Mass., 601,626. Filed Feb. 23, 1897. The pin completes an electric circuit connection with an annunciator at the other end of the alley.

SOLENOID BLOW-OUT FOR DISPERSING ARCS FORMED IN BREAKING ELECTRIC CIRCUITS. S. H. Short, Cleveland, Ohio, 601,717. Filed November 1, 1897. Employs a conducting coil having a central open space arranged in proximity to the contacts, being normally in shunt circuit with the contact, and means whereby the coil is introduced into direct circuit at the moment circuit is broken between the contacts.

ELECTRIC WELDING MACHINE. C. Neilson, Brooklyn, N. Y., 601,979. Filed June 15, 1897. Details of construction.

Railways and Appliances:—

RAIL-BOND. J. J. Dainton, Chicago, Ill., 601,707. Filed February 15, 1897. Is provided with tapered terminal sleeves entering tapered holes in the rail web from the larger side of the hole and removably expanded therein by the tapered drift-pins inserted from the same side of the rail-bond.

ELECTRIC BRAKE MECHANISM. A. Vanderbeck, Scarmon, Kan., 601,992. Filed Sept. 13 1897. Employs a magnet provided with contigous spaced poles, and a polarized plunger terminally disposed between the poles and magnet and adapted to be operatively connected with the moving parts of a brake mechanism.

Switches, Cut-Outs, Etc:—

ELECTRO-MAGNETIC CIRCUIT BREAKER. G. S. Dunn, East Orange, N. J., 601,871. Filed June 12, 1897. Comprises an electromagnetic circuit breaker having a latch thereon which permits it to move freely in one direction only, a resistance controlling switch and a part on the resistance controlling switch movable into the path of the latch.

Telegraphs:—

PRINTING TELEGRAPH SYSTEM. J. Burry, Fort Lee, N. J., 601,768. Filed September 10, 1897. A single line wire is employed in operating the type controllers and printing devices of the receivers. Details of construction.

Telephones:—

LOCK FOR TELEPHONES. R. H. Allen, Fitchburg, Mass., 601,786. Filed September 3, 1897. Consists of a base plate and brackets adapted to be secured in proximity to the call means of the instrument, and a swinging arm supported by the base-plate or bracket and adapted to engage the call means and to be locked in engaged position and to be unlocked with a key.

TELEPHONE. T. F. Ahern, Detroit Mich., 601,865. Filed April 26, 1897. The transmitter is suspended on a horizontal axis in a plane parallel to the diaphragm, and so journaled that the speaking tube is normally downward.

DETROIT, MICH.—The Detroit, Ypsilanti & Ann Arbor R. R. has decided to build another power house at Dearborn. It will be a duplicate of the one now building at Ypsilanti, with a complete Westinghouse equipment furnished by the Detroit office of Westinghouse, Church, Kerr & Co., engineers. The finest of cars, 44 feet long, with four 50 h. p. motors on each car, with Westinghouse air brakes, plate glass windows, toilet rooms and plush cushions, etc., will be used on the road.

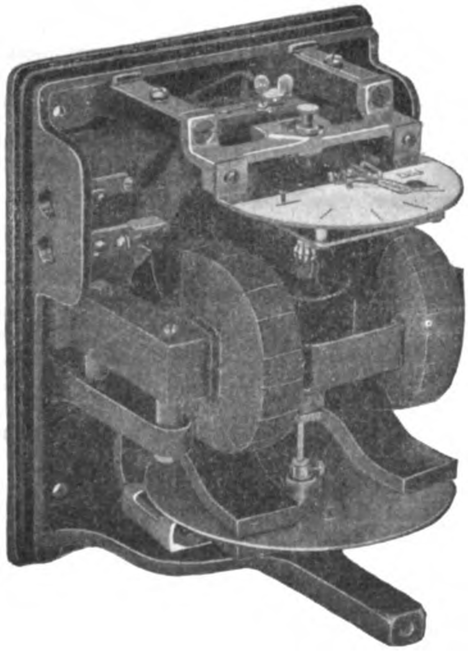
JERSEY CITY, N. J.—The Jersey City Electrical Construction Co. has been formed to carry on a general electrical construction business, with a capital stock of $10,000. The incorporators are H. Chewton, of Paterson; J. McCullough, of Jersey City; and I. M. Simonson, of Paterson.

TRADE NOTES & NOVELTIES

Thomson Recording Storage Battery Meter.

THE increasing application of storage batteries, consequent on their perfection, to electric light and railway station use, as well as to street cars, motor carriages, electric launches, etc., where a portable source of power is requisite, has led the General Electric Company to develop a special type of meter which will show at a glance the amount of energy available in the battery. The Thomson recording storage battery meter resembles in general appearance the standard Thomson recording watt-meter, and is, in fact, a development from it, the mechanism being almost exactly similar. The accuracy and durability characteristic of the standard type have both been maintained, while additional precaution is provided against injury from shock or vibration. The meter is provided with a single indicating needle moving over a horizontal semi-circular dial.

The essential requirement for a storage battery meter is that the armature shall rotate in either direction and give equally accurate readings in both. This requisite is fully preserved. The energy put into the cells is, therefore, added to the reading of the meter, while the energy withdrawn is subtracted, but to compensate for the loss in the cells, the meter runs more slowly when charging. The reading of the meter represents not the amount



THOMSON RECORDING STORAGE BATTERY METER.

of energy put into the battery, but the amount available, and when the needle points to zero on the dial it shows that the battery is completely discharged.

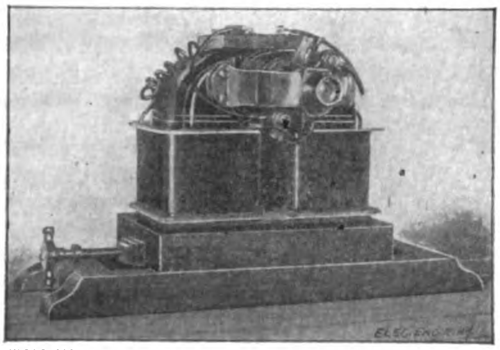
For motor carriage, street car and electric launch service, a meter of this character is a most necessary adjunct. Indeed, any of these vehicles of transportation not equipped with a device to warn the operator of the amount of current available to carry him forward on his journey or to bring him back to his starting point, would be incomplete. Without it he is absolutely ignorant of the power upon which he can depend, and would run serious risk of finding himself at a standstill far from home with no means of getting either forward or backward without recourse to some mechanical method.

The durability and efficient operation of storage cells being maintained by re-charging them before they are exhausted, the only method of learning of their exact condition is by a meter of this character. The cells being re-charged at the right time, the general result is a much higher battery economy.

These meters are manufactured with any desired percentage difference between charging and discharging rates, and in all of the standard sizes in which two-wire Thomson recording watt-meters are built. Since, however, this percentage varies in almost every case, the General Electric Company manufactures them only to order. One size, that reading to 50 amperes, however, may be considered as standard and will be more promptly furnished than any other.

New Apparatus and New Quarters of the Rochester Electric Motor Co.

THE Rochester Electric Motor Company, of Rochester, N. Y., to meet the growing demand for their direct current motors and generators have moved to larger quarters at the corner of Mill and Platt streets, that city, where with the increased room and more machinery they will be in a position to fill their orders more promptly. At present they are working evenings to catch up on their orders. Besides their regular dynamos and motors the company build special machines in the smaller sizes. All their machines embody the following commendable features: Interchangeable field coils, field magnets in one piece, sectional wound armatures, allowing the removal and replacement of single coils in case of accident, self-



THREE H. P. 100 VOLT ROCHESTER MOTOR.

oiling bearings, a combined carbon and copper gauze brush, and heavy insulation of the best quality. Mechanical lock starting boxes of their own design are furnished with their motors. The regular machines are built for 110, 220 and 500 volts and the speeds for the machines are 1,200 revolutions for the ½ to 5 h. p., 900 for the 6 to 8 h. p., 850 for the 12 to 20 h. p., and 500 for the 25 h. p. The company have just built a 3 horse power 100-volt machine, shown in the figure, for the Stecher Lithographing Company, of Rochester, which is direct connected to one of their box machines and will be shipped to London, England. The officers of this flourishing company are F. C. Kimmel, president; Edw. F. Davison, secretary and treasurer; P. J. McDonald, superintendent.

Stagnant Air as a Poison.

The landlocked harbor of Havana, with its narrow opening into the sea but two or four hundred feet wide, is one of the most malignant bodies of water. Although the tide rises and falls there is no circulation of water in the harbor and no fresh water comes in. All of the drainage of Havana goes into the harbor, and at the present time the wharves are so filled with the germs of disease caused by decaying matter and stagnant water that vessels are compelled to unload in lighters rather than risk the danger incurred by tying up to the wharves. The stirring up of the bottom of the harbor produces an effluvia extremely dangerous to the lives of the crews of the ships in the harbor. If this harbor were properly drained and a constant current of fresh water pumped in to replace the foul water, the danger from diseases would be lessened and probably eliminated. Yet in many workshops, school rooms, stores and offices, the air becomes surcharged with carbonic acid gas and gradually loses its proportion of life-giving oxygen until it becomes as foul and dangerous to health as the filthy water in the Havana Harbor, and the people breathing this vitiated atmosphere soon become stupid and inactive. Stagnant air due to want of ventilation is too frequently overlooked, although with better air more work of better character can be done. By the proper use of fan motors the air can be freshened and the injurious effects referred to appreciably lessened, and in many cases entirely eliminated. The modern fan motor in all its different phases from the large exhaust fan to the small desk fan is admirably

fitted for this purpose. The more the public becomes educated regarding the uses and advantages of fresh air and the means of obtaining it so much the better will be the health of the communities wherein the fan motors are employed.

Keuffel & Esser Co.'s Drawing Materials.

KEUFFEL & ESSER CO., 127 Fulton street, New York, manufacturers and dealers in drawing materials and surveying instruments, have recently published a richly illustrated catalogue of over 400 pages, describing their most complete assortment of goods of the highest standard, and is scrupulously exact in its statements and claims. To give some idea of the rich assortment offered by them, we give a number of illustrations of slide rules listed in their catalogue. Slide rules, although invented long ago, have only lately come into a more general appreciation and are now used in nearly all professions and trades, thanks to their improved and simplified form and greater accuracy. Fig. 1 shows the Thacher Calculating Instrument, the most complete slide rule made, containing over 33,000 divisions, and scales 30 and 60 feet in length. The duplex slide rule, Fig. 2, is graduated on both sides, and the slide faces on both sides. A metal runner encircling the rule enables coinciding points of the scales on either face to be at once found. This rule is furnished also in one-half size, with the same number of graduations as the full size. The well-known Mannheim slide rule, shown in Fig. 3, with a celluloid facing, is listed with metal and with glass runner in 5, 10 and 20-inch lengths. The Guntner slide rule, now largely superseded by the Duplex and Mannheim, is of boxwood, and is made only in the 10-inch size. The Student's slide rule, Fig. 4, 10-inch, paper faced, is intended for students who want a low priced rule for instruction and practice. It is not intended for professional use. All these slide rules are furnished with very complete directions, so that their employment does not require a knowledge of logarithms, etc.

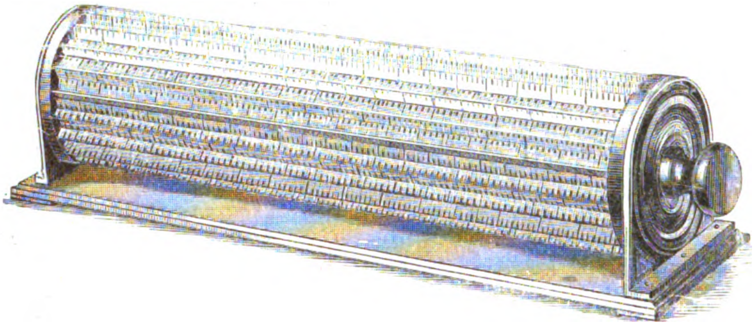


FIG. 1.—THACHER CALCULATING INSTRUMENT.

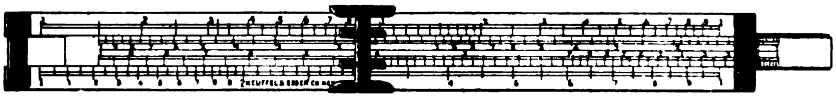


FIG. 2.—DUPLEX SLIDE RULE.

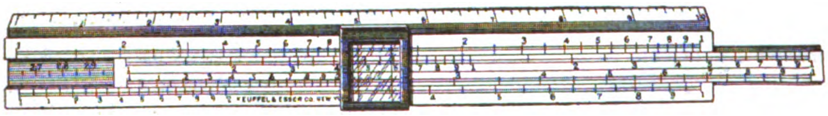


FIG. 3.—MANNHEIM SLIDE RULE.

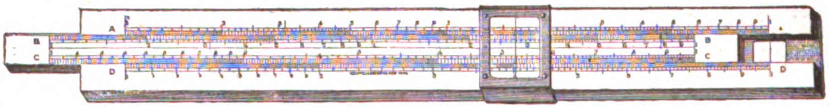


FIG. 4.—STUDENTS' SLIDE RULE.

Besides these they list and carry also the Fuller's slide rule, which has a spiral scale 42 feet long, and the Charpentier and Boucher slide rules, which are disc shaped and intended for the pocket, but are inferior to the straight slide rules. All the above slide rules, except the Fuller, Charpentier, and Boucher, are manufactured by Keuffel & Esser Co. There are listed also slide rules for special purposes, like stadia reductions and sewer computations. Other goods are manufactured in the same or even greater variety, and fully described in the catalogue and carried in stock A visit to their store, 127 Fulton street, woulld be of interest and practical utility to any professional man.

The Montauk Multiphase Cable Adopted by the Gamewell Auxiliary Fire Alarm Co.

THE Montauk Multiphase Cable Co. have originated and developed a new line of cables which, when installed for any or all kinds of interior electric service give to property owners and to insurance companies an additional protection against loss by fire, always sought for, but heretofore unattained. This system gives to wires the power to discover dangerous heat or flame and automatically to notify at any point or points desired that such heat or flame is in existence, and this upon its inception.

The great merit and pronounced value of these cables which have already been described by us, is due to the fact that they are not required to be especially installed for this purpose, but on the contrary, are used in buildings for all of the interior electric work which is at the present time required—therefore, every fractional part of every wire or cable hereafter installed under the Montauk cable system is continuously thermostatic and results in giving protection from loss by fire, although installed for purposes of an entirely different nature.

The property holder is not only benefited by gaining additional protection for life and property, but the insurance companies have an additional guarantee against loss through the use by the public of this system. The value of the endorsement and adoption of the Montauk Multiphase Cable Company's system of interior, automatic, thermostatic, electric cables by the Gamewell Fire Alarm Company, and its auxiliary companies for their specific use will, therefore, be readily understood and appreciated when it is taken into consideration that the Gamewell Co. is the parent of the present extensive fire alarm system which is in use in over 700 of the largest cities of the United States, and has furnished more than 90 per cent. of all the fire alarm apparatus used in the United States and Canada.

It is from their experience of 50 years, or more, of endeavor to give the most reliable and quickest possible notification of fire

in existence that makes such endorsement of the greatest possible value,, for if this company are not experts and capable judges in such matters, there can be none in the United States.

We therefore note with satisfaction these main points brought out in the letter to the Montauk Company, printed below. The statement that "this cable has received full consideration by the Gamewell people," shows that that company has come to the conclusion that an automatic protection can be safely given in connection with their fire alarm system where no other device has ever been relied upon; in other words, they are willing to rely upon the burning of the Montauk cable to close the circuit and thus automatically call out the forces of the fire department through their auxiliary system. Following is the letter:

Montauk Multiphase Cable Co.,
100 Broadway, New York City.

Gentlemen: Herewith we send you formal acceptance of your proposal for furnishing us with your "multiphase electric cables."

After full consideration we have come to the conclusion that we will find, through the use of your cable, something long known to be desirable but hitherto impracticable, viz., a device which we can safely use for the purpose of combining thermostatic fire alarms with our auxiliary system of connection with public fire alarm telegraphs. Yours truly,

GAMEWELL AUXILIARY FIRE ALARM CO.
JOS. W. STOVER, President.

March 30, 1898.

The Jandus Enclosed Alternating Arc Lamp.

A VERY successful alternating enclosed arc lamp of the non-focusing type for circuits of from 7,000 to 16,000 alternations per minute, and voltages from 100 to 120, is being manufactured by the Jandus Electric Company, of Cleveland, Ohio. The design of the lamp, which is shown below, is pleasing and short (thirty inches), and embodies certain characteristics of

JANDUS ALTERNATING ENCLOSED ARC LAMP.

construction that have always been characteristic of the Jandus products, the principal of which are the ring type of clutch, the carbon grip, and the substantial construction in general. The mechanism is so arranged that all joints or pivotal connections between moving members are taut at all times, so that there is no lost motion to take up either in drawing the arc or during the operation of the lamp, and for this reason an absolutely noiseless mechanism is obtained. The solenoids are substantially wound and mounted on vibrating members from which they may be easily removed. A reflecting surface is provided (not shown in the figure), and arranged as a part of the globe cap, which greatly increases the effective illumination, and decreases the heat transmitted to the mechanism from the arc. A reactance (or economy) coil is placed in the canopy of the lamp, easy of access and conveniently adjusted for the voltage of the arc. The efficiency is high, showing a loss of but 20 watts as the lamp is ordinarily adjusted, i. e., 6 amperes on 100 to 110 volt line. The lamp ordinarily consumes from 400 to 450 watts across the terminals, thus showing an average efficiency of 95 per cent. The carbons furnished with lamp consist of an equal number of 1-8 inch core and 1-16 inch core, each 8 inches long. By using the stub of the upper carbon for a lower in the succeeding run, but one fresh carbon per trim is necessary. One 1-8 inch core and one solid carbon give good results. The life of one pair of carbons is about 80 hours.

Lamps for outside service are similar in design to inside lamps, except that they are provided with a weather-proof top, and the finish of the case is a dead black. Inside lamps permit of any finish desired, and are susceptible to highly artistic ornamentation.

Improved Type of the Hatch Storage Battery.

APPRECIATING the wide field now developing in all branches of electrical work for a storage battery of high efficiency, light weight, durability and compactness, the Hatch Storage Battery Company, of Boston, Mass., after long and careful research among those skilled in the art, has secured to itself the exclusive rights to manufacture the improved type of the Hatch Storage Battery, which is described and illustrated below.

In the improved Hatch element, there is no new chemical or electrical principle involved. The invention is of a purely mechanical nature, and relates to the construction of the element, which is practically solid, and integral in all its parts, reducing its weight to the minimum amount of lead oxides necessary to do a given amount of work, and their mechanical support of light material.

An examination of the construction of the cell will show

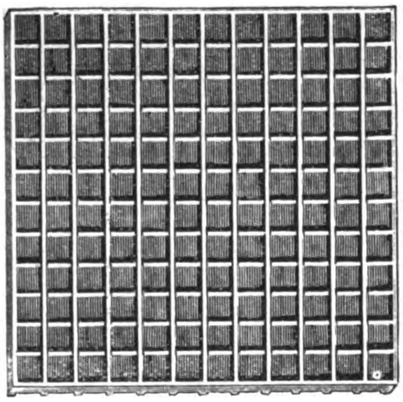


FIG. 1.—POROUS PLATE OF UNGLAZED EARTHENWARE; SQUARED FACE.

how simply and effectually the oxides are locked up in their support, while they are also freely accessible throughout to the electrolyte of the cell. This is also accomplished without any undue compression of the active mass, so that an absolute maximum of porosity throughout is maintained, while the plugs of the active agent are thoroughly exposed on all sides to the electrolyte. The elasticity of the element also provides for a maintenance of this porosity during the charging and discharging processes, which is so essential during any heavy regime of work for the maintaining of potential.

The inventor had in mind the fact that the only materials in a storage battery which actually contribute to the storing of chemical energy, are the metallic oxides and the electrolyte, and to bring these two elements together, with a minimum of mechanical interference, has been his thought and aim.

The electrical efficiency of a storage cell is determined primarily by its internal resistance, and this, in its turn, is governed by the freedom from interference with its chemical and

electrical operation. Purity of material, with a minimum of the mechanical parts, and porosity of the active agent and its mechanical support, to admit of the free distribution of the electrolyte therethrough are the essentials.

The construction of the cell secures all these points perfectly,

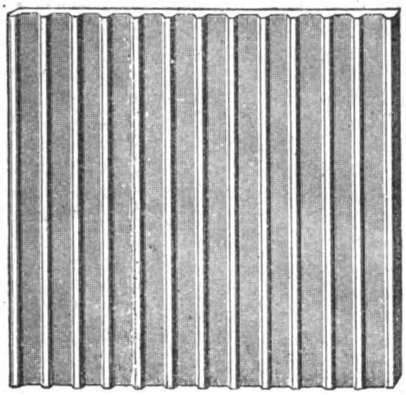


FIG. 2.—POROUS PLATE OF UNGLAZED EARTHENWARE; GROOVED FACE.

and the internal resistance of the 100 ampere hour cell is 25-10000 of an ohm, and other sizes in direct proportion—while the weight of the element to do a given amount of work is reduced fully one-third—as compared with the grid type.

In constructing the element, a porous plate of unglazed earth-

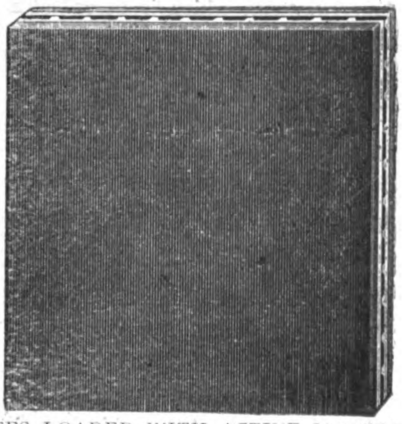


FIG. 3.—PLATES LOADED WITH ACTIVE MATERIAL PLACED TOGETHER.

enware is used with square receptacles on its face side, and grooves on its reverse side as shown in Figs. 1 and 2. To the face side of each plate, the lead oxide or active agent is applied, filling the mass one-eighth of an inch above the surface of the plates, so as to secure an agglomeration with the electrode dur-

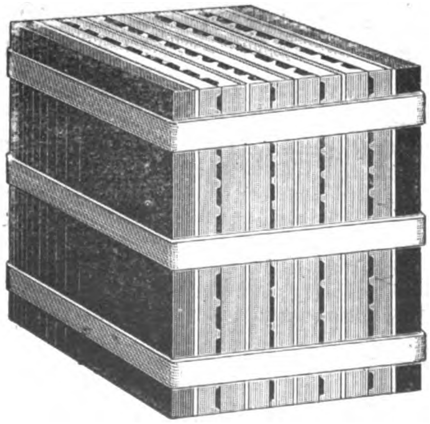


FIG. 4.—ASSEMBLED ELEMENT.

ing the forming process. The plates thus loaded with the active agent are then placed together, back to back, with the grooves crossed, as shown in Fig. 3. This forms one couple, positive and negative, of the element.

A series of these couples are then assembled, as shown in Fig. 4, to form the complete element, as many couples being associated as is necessary for the required capacity.

The sides of this element thus assembled are flanked with a rigid support plate of glass, or similar material, and then en-

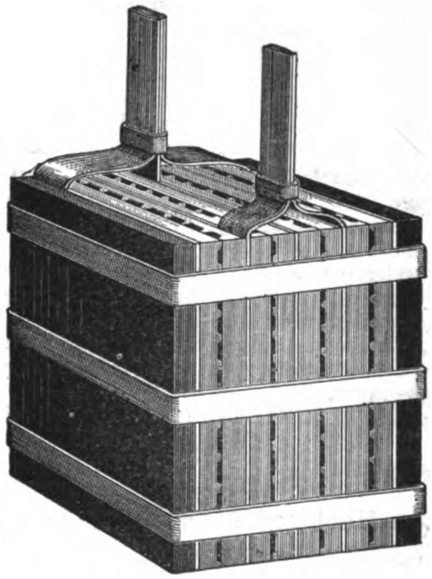


FIG. 5.—COMPLETED ELEMENT WITH ELECTRODES INSERTED.

circled with heavy rubber bands, as shown in Fig. 4. The electrodes are then applied in any desired form, but ordinarily they are applied in the form of lead sheets, interleaved with the active material, as shown in Fig. 5. Reference to this figure as a complete element, will show how permanently the oxides are locked

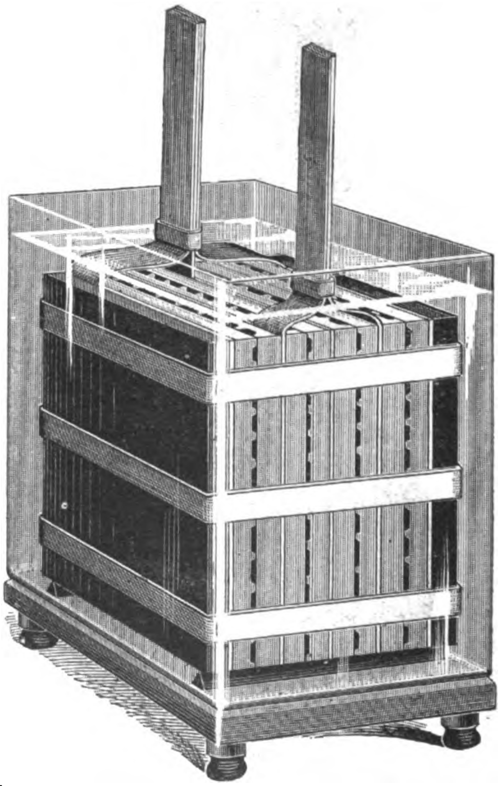


FIG. 6.—THE HATCH STORAGE BATTERY; COMPLETE.

up, while the porosity of the entire mass is secured so that it will remain porous during the work, as the elasticity of the element allows for the expansion and contraction of the active material without closing the pores of its own mass. Provision is also made for free circulation of the electrolyte between the plates, and at the same time allows a free escape of the gases formed by electrolysis.

The battery is splendidly adapted for central station work, as

no amount of current in either direction can possibly injure the element—and the absolute confinement of the active material avoids deterioration by loss of that important agent.

The elements being practically solid, can be used for traction and carriage service without danger of disintegration by jolting, or concussion, and the company are ready to guarantee it for either train lighting, street car work, or any form of carriage service. In all this class of work, the wide variations in output of current called for in climbing grades, rounding curves, etc., make it necessary that the mechanical construction of the element should be adapted particularly for this work. The construction of the Hatch element secures the three desirable qualities: light weight, durability and efficiency.

The company guarantee the maintenance of its accumulators for ten per cent. per annum of their original cost when used for installations for large capacity, like central station work or railway carriage service; provided always, that in such cases, the working of the plants is properly done and within reasonable limits. Such a guarantee makes it absolutely sure to the purchaser that the depreciation will not exceed that of any class of machinery in other lines.

The elements are furnished in plain glass jars as shown in Fig. 6 or in cabinets and portable forms and are built in all sizes ranging in capacity from 5 to 300 ampere hours. They are placed upon the market by The Hatch Storage Battery Company, 53 State street, Boston, Mass., who will gladly furnish estimates and send their illustrated circular to anyone upon application.

NEW YORK NOTES.

WESTERN UNION TELEGRAPH COMPANY has declared its regular quarterly dividend of 1¼ per cent.

ELECTRIC WIRING CO., of Orange, N. J., has been formed, with a capital stock of $150,000, by K. Eppley and W. A. Johnson, of West Orange, and others.

THE LECLANCHE BATTERY COMPANY, 111 East 131st street, New York, report their works busy. They manufacture the well known "Gonda" also the "Vole" open circuit batteries.

AMERICAN SUGAR REFINING CO., of Brooklyn, N. Y., are placing a new fireproof roof over their No. 1 boiler house. The roof will be fireproof, consisting of steel trusses covered with corrugated iron, and is being furnished by The Berlin Iron Bridge Company, of East Berlin, Conn.

COBB-CHAMBERS CO., decorators, 14 Park Place, New York City, have distinguished themselves by their clever work at exhibitions, shows, etc., and are now in line for a large amount of work at the approaching Electrical Exhibition. They issue a tasteful pamphlet illustrated by many pictures of their achievements, large and small, and will be glad to receive and answer inquiries. Orders should be filed at once.

MR. M. A. SINGER, 27 Bond street, New York, who is well and favorably known to many electrical concerns, is preparing a number of tasteful displays for exhibitors at the May show in Madison Square Garden. He will be glad to give information as to prices for fitting up spaces, and for rail, rugs, draperies, carpenter work, etc. His experience in this line will be useful to a great many who need such services.

THE LUNDELL MOTOR seems to be gaining rapid recognition among large power users, owing to the fact, it is stated, that it has never lost in competition with other motors at the hands of engineers, and the further fact that it has given invariable satisfaction during all the years it has been upon the market. One of the latest contracts awarded the Sprague Company is that awarded by the John Stephenson Car Company, of Elizabethport, N. J. Each of the Stephenson machines will have its independent Lundell motor, and the sizes used will be from three to forty horse power, mostly large size machines. Some of them will be direct connected, and some geared. In addition to the power motors, the Sprague Company has secured a contract for exhaust fan outfits. The plant will be one of the largest of its kind in the country, and will employ only Lundell motors.

MR. A. E. WINCHESTER, E. E., of South Norwalk, Conn., was a visitor to New York recently. He is very busy with the details of the extension of his municipal plant. It is understood he will run his lamps at 220 volts.

WESTERN NOTES

EUGENE MUNSELL & CO., importers and wholesale dealers in "Mica," of 117 and 119 Lake street, Chicago, are sending to the trade a blotter, which is rather artistically gotten up and refer to the rapid growth of their business as being the strongest evidence of the superiority of their "Mica." They make a specialty of "Mica" for stove and electrical purposes. A funny little man is illustrated as making quick delivery from a great stock of "Mica" in a great city.

DETROIT, MICH. The Detroit Switchboard and Telephone Construction Company, 330 Lafayette avenue, Detroit, Mich., will be pleased to receive catalogues of metal and woodworking machinery and of electrical supplies of all kinds.

TWELVE WESTINGHOUSE ENGINES will furnish the power for lighting the new steamers being built by the Moran Bros. Company at Seattle, Wash., for service on the Yukon river.

WALKER CO.'S bulletin No. 1070 for April deals with their "converted type" of belted generators, which it describes and illustrates in detail.

THE CITY OF CHICAGO has appropriated $150,000 for the extension of its municipal lighting system. Ten 150 light arc machines of the Western Electric Company's manufacture have been ordered by the city.

TOLEDO, O. Messrs. J. Scott and Bert Christian have formed a partnership for electrical construction under the name of Scott & Christian, with offices in the Valentine Building. They are well known, and already have several nice contracts.

CENTRAL ELECTRIC CO. Chicago, are carrying in stock Edison fuse plugs of all sizes, standard fuse wire put up in neat and attractive packages convenient for use, fuse links with copper terminals of all lengths and capacities, as well as a full assortment of fuse strips. The composition entering into their various fuse material is the result of numerous experiments, and practical tests have determined its value.

USERS of miniature incandescent lamps appreciate the advantage of having a miniature lamp of standard make that can be depended upon for efficiency and length of life. The Packard sign lamp, which is a miniature lamp about 2 inches long over all and 1 inch in diameter, fills the demand for a high grade miniature lamp. It is mounted with regular Edison candelabra base, gives about two candle power and burns 4 in series on 50 to 60 volts or 8 in series on 100 to 120 volts. This lamp is carried in stock in Chicago in large quantities by the Electric Appliance Company, who always hold themselves in readiness to ship promptly any number of these lamps and the necessary sockets.

NEWGARD WATER PROOF RECEPTACLE AND GLOBE, recently patented, is finding a large field of usefulness in breweries, paper mills, packing houses, sugar refineries, and all other places where moisture or fumes make the insulation of an ordinary lamp socket a difficult proposition. The price of this device is down to a point where it is economy to use it in all places where high insulation is required. The Newgard receptacle and globe is so simple in construction and yet so clever in its conception that it commends itself to every one at first sight. The Electric Appliance Company are always glad to submit a sample of this globe where there is a possibility of their adoption.

NATIONAL CYCLE MFG. CO., Bay City, Mich., H. B. Smith, president, have issued some good literature with regard to their excellent wheels, which have many special features in chain adjustment, seat post, handle bars, detachable sprockets, crank hanger brackets, forged arched fork crown, etc. Frames are made 22, 24 or 26 inches in height, and three colors are used in decoration. The tires are the best on the market, saddles are Sager or Gilliam. Mr. Smith is well known in electrical circles as the secretary and treasurer of the Michigan Pipe Co.

HARTFORD, CONN. The Hartford City Gas Light Company has placed another contract with the Berlin Iron Bridge Company of East Berlin, Conn., for one of their steel roofs with patent anti-condensation fireproof roof lining, which has given the Gas Light Company much satisfaction in the past. The new building is about 35 feet wide and 70 feet long, having brick sides and iron roof constructed as mentioned above.

ADVERTISERS' HINTS

SPRAGUE ELECTRIC CO., 20 Broad street, New York, are advertising a fan outfit for suspension from a ceiling. The fan bades and guard may be turned in any direction.

THE COULTER & McKENZIE MACHINE CO., Bridgeport, Conn., manufacture cross arm braces, plain or galvanized, for telephone and electric light work, also feeder brackets for trolley wires.

THE COBB-CHAMBERS CO., 14 Park Place, New York, take entire charge of designing, building and decorating exhibits.

C. S. KNOWLES, 7 Arch street, Boston, Mass., says that danger from grounding or short circuit is entirely eliminated by the use of the "Erickson" outlet insulators. They are made in a durable form, have a threaded metal member to receive the conduit pipe, and the outer end is enveloped by high grade insulating material.

THE STANDARD TELEPHONE AND ELECTRIC CO., Madison, Wis., claim a record of having installed 50,000 instruments, in use in 400 exchanges and all doing satisfactory work.

BOOTHS FOR THE ELECTRICAL SHOW may be ordered from M. A. Singer, 27 Bond street, New York. Estimates and sketches will be sent on request.

THE WAGNER ELECTRIC MFG. CO., St. Louis, Mo., are building single-phase, self-starting alternating current motors, which are said to be a success in every respect.

THE C & C ELECTRIC CO. have changed their Boston office to 19 High street.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., advertise the "Packard" sign lamp, a miniature lamp burning four in series on fifty volts or eight in series on one hundred ten volts. They claim high efficiency and long life for them.

THE GARTON-DANIELS ELECTRIC CO., Keokuk, Iowa, have had a great increase in the sale of their lightning arresters. Their January and February business for 1898 was over 300 per cent. greater than for those months last year.

WESTINGHOUSE, CHURCH, KERR & CO. as engineers and Westinghouse Machine Company, as manufacturers, represent a most excellent combination of engineering experience and manufacturing facilities, which should guarantee the most excellent service to those interested in the generation of power—steam, gas or electric.

THE WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, are ready with their 1898 models of electric fans.

THE WALLACE BARNES CO., Bristol, Conn., advertise springs of every description, and a large assortment of cold rolled steel.

THE ELECTRICAL EXCHANGE, 166-174 South Clinton street, Chicago, present a revised list of bargains in electrical machinery, lamps, instruments, supplies, etc.

A. L. IDE & SONS, Springfield, Ill., publish a decision recently awarded them on patent rights.

CENTRAL ELECTRIC CO., 173-175 Adams street, Chicago, advertise new prices on wire, line material and tools.

THE MONARCH MFG. CO., 39 Cortlandt street, New York, are introducing the "Monarch" engine stop and speed limit. This device is to an engine what a safety valve is to a boiler. It is designed to close the throttle when a predetermined speed is reached.

G. M. ANGIER & CO., 64 Federal street, Boston, Mass., have something to say about their long-burning series arc lamp.

THE JANDUS ELECTRIC CO., Cleveland, Ohio, say that 25 single carbons at the trivial cost of 75 cents is all that the Jandus lamp will consume in one year. Their new catalogue is now ready and describes the different varieties of the "Jandus" for all classes of service.

THE PHOENIX CARBON MFG. CO., St. Louis, Mo., claim that the interlocking device of the Phoenix batteries stands at the head, and they mention many other strong points in its favor.

THE PENNSYLVANIA RAILROAD has ordered for its Altoona shops two 160 h. p. tandem compound engines, arranged for direct connection to 100 kilowatt dynamos. The engines are furnished by the Ball Engine Co., Erie, Pa., and dynamos by the General Electric Co.

FOREIGN NOTES

WALKER, BAILEY & CO., of Buenos Ayres, Argentine Republic, are now installing the first outfit of electric motors for supplying all of the motive power in a factory, that has ever been installed in that country. The plant is for a weaving factory, and is to be driven by Lundell electric motors of such power that each motor will drive six machines. There are instances where it is advisable when putting in electric motors, to fit each machine with a separate motor, but in this instance the machines are always in operation.

WESTINGHOUSE ELEC. AND MFG. CO. has just opened a new branch office at Austin, Texas. Mr. J. E. Johnson will have charge of the office and of the further extension of Westinghouse business in the Southwest. The large contracts which this company has been handling in Mexico and the Texas region have compelled the establishment of this new centre of electrical trade.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. APRIL 21, 1898. No. 520.

TELEPHONY AND TELEGRAPHY

The New Bell Telephone Plant in St. Louis, Mo.

BY FRED E. BAUSCH, E.E.

Distributing Head.

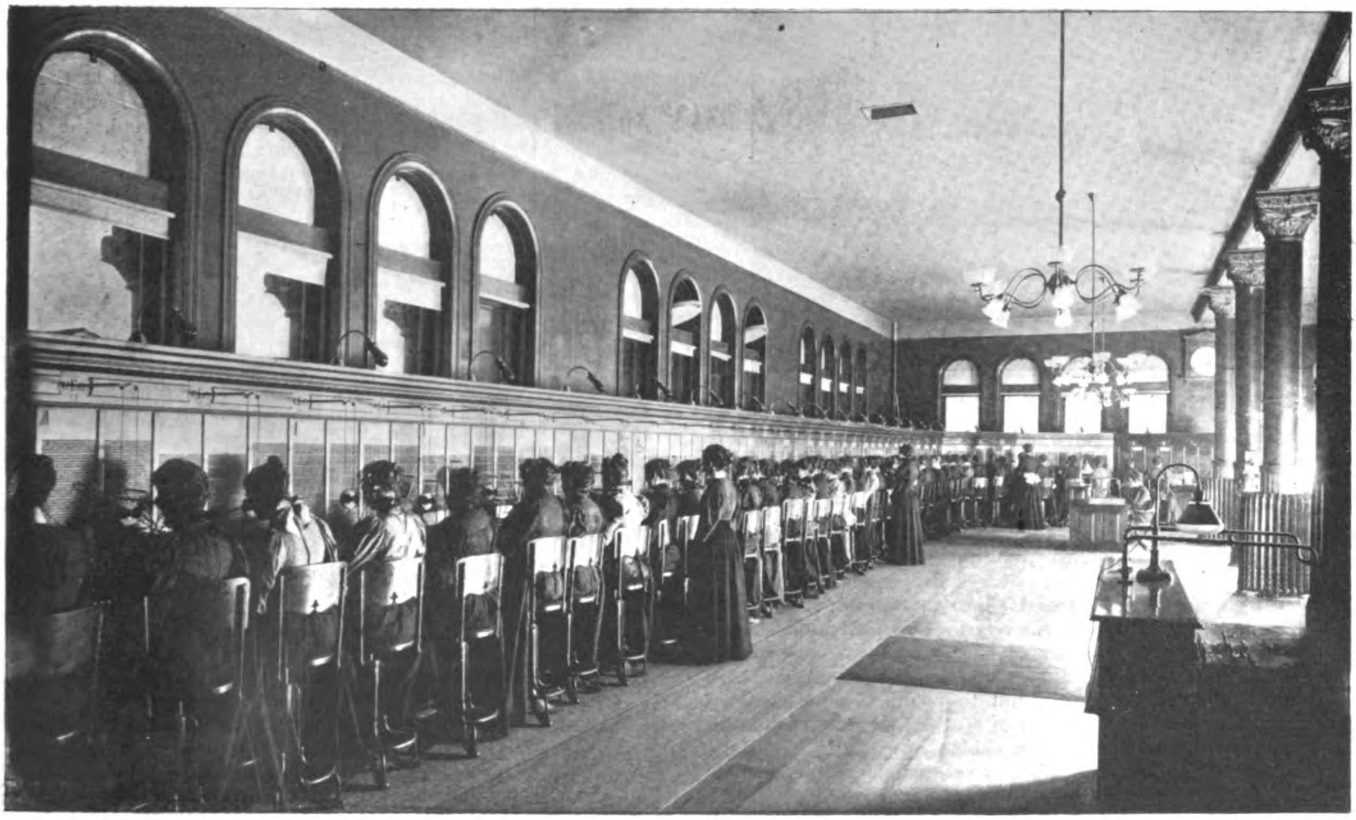
THE development of the art of telephony ranks preëminent amongst enterprises associated with electrical progress. From the day of the first public exhibition of the transmission of speech over wires, at the Centennial in 1876, to the present day, of the mammoth telephone switchboards where tens of thousands of wants are satisfied daily, and distance is robbed of its true meaning, the evolution of the telephone industry and its stupendous growth is indeed significant. Since the inception of the telephone it has been the persistent aim in the telephone business to maintain the highest standard of efficiency, and meet the increasing demands on the system most expeditiously, to which end it has involved unlimited capital, brains, and the untiring efforts of thousands engaged in the work.

The 22d of April marks the twentieth anniversary of the existence of the Bell Telephone Company of Missouri, operating in St. Louis, in connection with an extensive network of toll line system throughout the State of Missouri and parts of Illinois. The original exchange, then established at 417 Olive street, and opened with a patronage of four subscribers, was based on the magneto system. The receiver and transmitter for all practical purposes were alike and correspond in construction to the present form of receiver. The Blake transmitter had yet to be invented, and with it was introduced a form of battery transmission.

The Law system of horizontal multiple switchboard with local battery was subsequently adopted. In later years the installation was supplemented by the Dean common battery system, an invention of the company's former electrician, and metallic service for local and long distance transmission.

With the natural expansion of the business of the various wire using companies, St. Louis was one of the first cities to appreciate the benefits of underground service. Its telephone company long since urged permission to bury its wires, but was hampered by municipal legislation, until the appointment of a Subway Commission by the Mayor in November, 1893. After a systematic study of the experiences of other large cities in this country and abroad, followed by dilatory legislation, an ordinance was adopted on Sept. 8, 1896, and is the one now in vogue, regulating the construction and operation of underground conduits in St. Louis. The ordinance, in brief, provides that no wires, tubes or cables, conducting or transmitting electricity, shall be placed above the surface of the street, alley or public place in the district of the city bounded on the east by the Mississippi River, on the west by the west line of 22d street, on the north by the north line of Wash street, and on the south by the south line of Spruce street, and its prolongation to the west line of 22d street after Dec. 31, 1898, except those necessary for connections for local distribution. The ordinance further provides that poles may be placed in the alleys for purposes of distribution, provided plans have been approved and permits have been issued by the Board of Public Improvements.

On April 19, 1897, ground was first broken preparatory to the construction of the conduit system of the Bell Telephone Company of Missouri. After an interval of precisely four months, on August 17, cable was drawn in through the ducts, and by the last of the year an underground system was perfected, of an order, and in an expeditious manner, the like of which has been rarely before attempted.

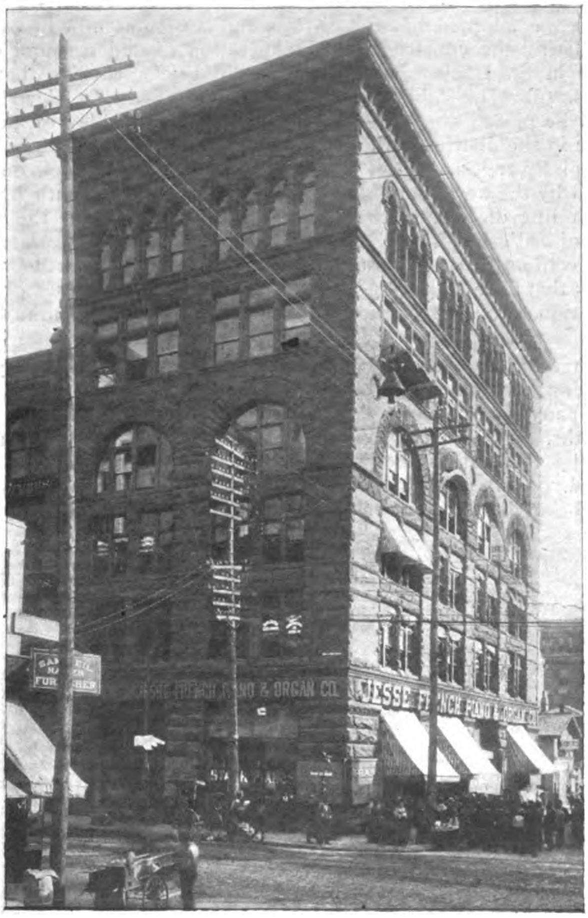


NEW TELEPHONE EXCHANGE OF THE BELL TELEPHONE COMPANY OF MISSOURI.

A reference to the accompanying map of the underground district clearly indicates the plan of distribution adopted by the

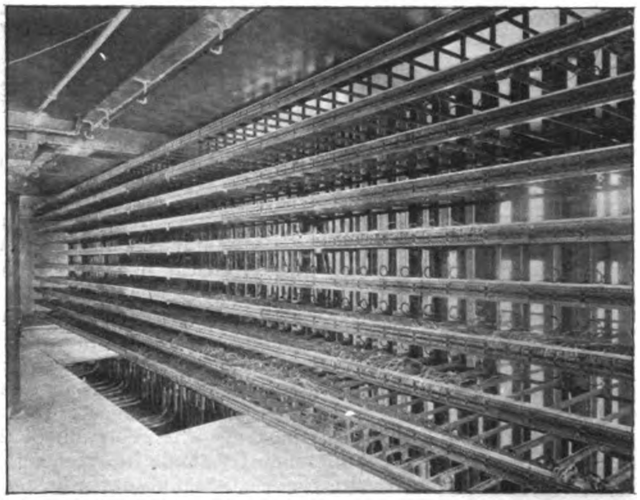
Bell TelephoneCompany of Missouri. The three backbones run east and west on Olive street, north and south on 10th and 4th streets. Tributary to these are mains running north and south or east and west as the requirements demand, and in turn led off from these are the various distributing lines which run in the alleys and are tapped at intervals through laterals, to supply office buildings, by cable containing a number of circuits or distributed to individual subscribers by single pair cable. (See page 422.)

Twelfth street divides the subway territory into east and west districts. In the latter, terminal poles are located at the entrance to alleys intersecting the streets, carrying the runs. The cables on leaving the manholes are led through three inch iron pipes to the terminal poles and terminate in a cable head. The various circuits are from here distributed by short overhead lines to the telephone subscribers. East of 12th street, which is the business district of the city, the underground construction has been rigidly adopted. As before, manholes are located at the entrance of alleys, but in place of erection of an alley pole line,



TELEPHONE BUILDING, 10TH AND OLIVE STS., ST. LOUIS, MO.

a distributing duct entering the street manhole is run along the alley, having a manhole in its centre and one at the end where the duct is dead ended. The cable-head is located in the manhole in the centre of the alley, and distribution effected from this point. Along the distributing duct, at intervals determined with reference to the requirements, junction sections are inserted, from which the single pair lead covered cables are led through three inch iron pipe (called laterals) into the basement or cellar of building in which the subscriber is located. In office buildings containing a large number of subscribers, an entire cable enters the basement and terminates in a large cable-head where each wire is separately brought out to terminal posts. From these the circuits issue in the form of a cable, which on reaching the various floors, is spliced with cables of smaller units, the latter terminating in smaller cable boxes, from which the final circuit to the subscriber's instrument is completed. This arrangement permits of changes such as are likely to arise through the new location of subscribers or for other reasons. The distribution tile (known as the Johnston duct, from the name of the inventor, who has immediate supervision of the subway construction) is unique. The tile, made in two-foot lengths, consists of two through ducts for single pair cables, one enclosed cable duct and a shallow channel above the same, permitting a device used for drawing in the single pairs. The junction sections are

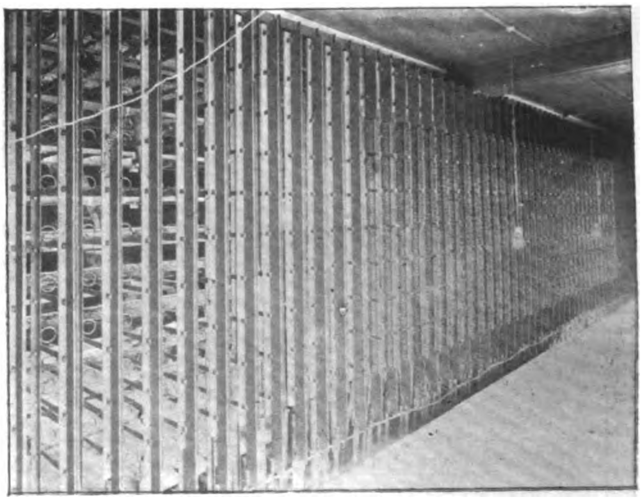


MAIN DISTRIBUTING BOARD, HORIZONTAL SIDE.

identical with the distributing tile, excepting a three-inch side opening for lateral connections.

All the main runs, with few exceptions, consist of 3¾-inch hollow brick tile 18 inches long, of octagonal exterior, made of sewer pipe clay, glazed inside and out, and manufactured by the local firm of Evens & Howard. The short lengths of tile proved to be a very flexible means of conduit construction, as it was comparatively simple to evade obstructions or adapt the course of conduit to unfavorable conditions, frequently encountered. This pipe was laid 5½ inches between centres, the intervening space being filled in with cement mortar. The successive rows were separated vertically by a ½-inch layer. Joints were made abutting, encased by mortar, one part cement to two parts sand, and broken horizontally and vertically. A mandril was drawn through the ducts as the work progressed to preserve the alignment and prevent the mortar from entering the duct. The mandril consists of a cylindrical piece of wood, three feet long, large enough to clear the duct, with washer attached at the inner end, and a hook for withdrawing it at the outer end.

All cement used was the best American Portland, the concrete foundation for the conduit ranging from four to six inches, according to the layers of duct. The sides and top of conduit were encased by three to four inches of concrete mixed in the



MAIN DISTRIBUTING BOARD.—VERTICAL SIDE.

proportion of one part cement, three parts sand and six parts broken stone.

A notable instance of the ease with which difficulties were surmounted with this form of tile is that shown in the view, illustrating the "fanning out" of two layers of tile into a single layer,

necessary because of the very shallow depth allowable for the conduit over the 8th street tunnel. In several localities where obstructions consisted of a network of interfering gas and water pipes, iron pipes were resorted to and bent into shapes best adapted to conditions.

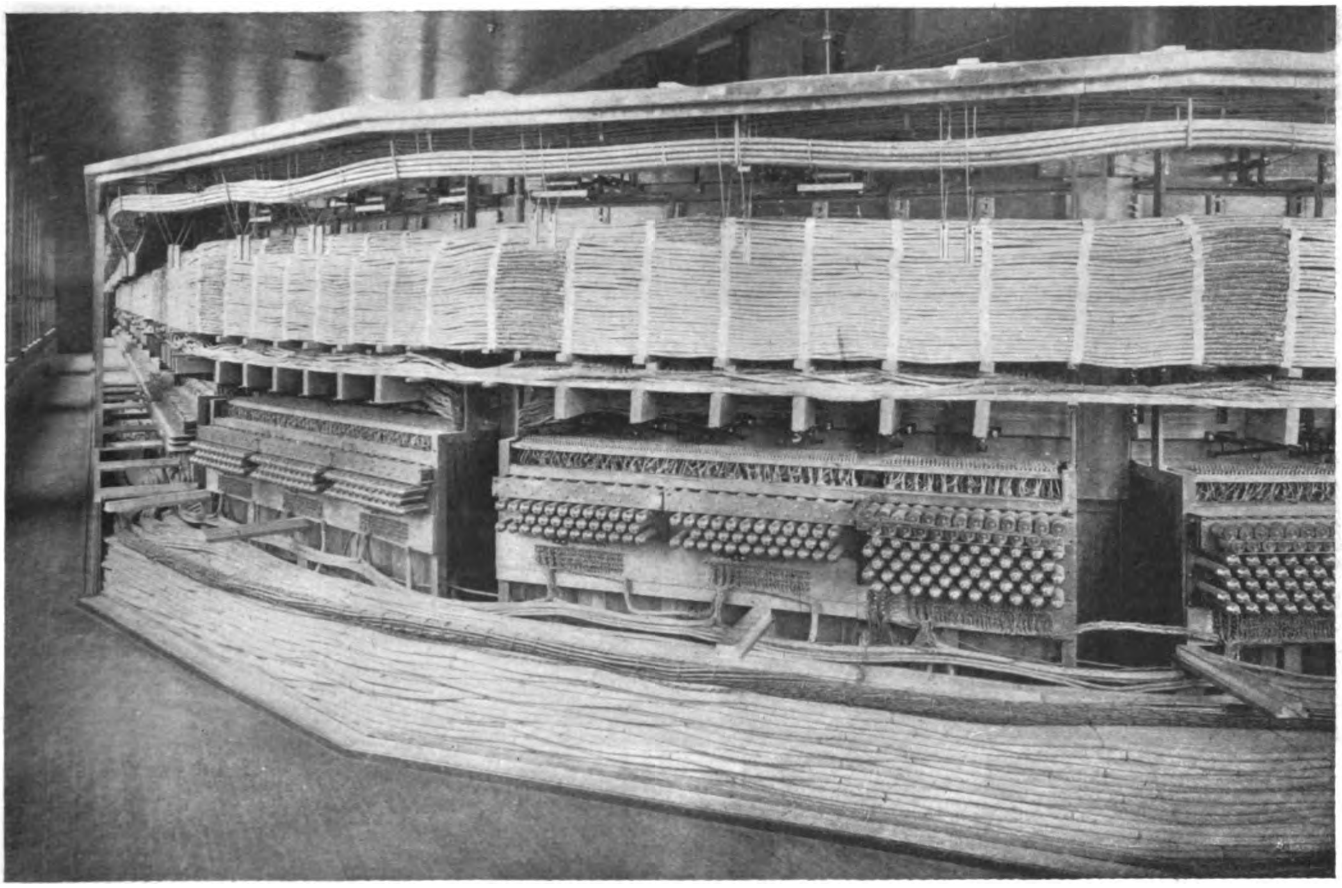
The multiple duct, of which but a short run was installed, was in the nature of an experiment. It consists of four rectangular compartments, 3¾ inches wide by 4 inches high, with 1-inch walls. It is made in two-foot lengths and intended only for places where multiples of four ducts were used, since the roof of one layer is formed by the bottom of the next layer above, which has grooves on the lower surface to fit in tongues formed by the walls of the layer beneath. The last layer above is covered by an arched sheet of mild steel, No. 22 gauge, and bent to lap over the sides. As in laying other styles of conduit, the sides and top are encased in concrete, the foundations and general work being identical. This type of duct was laid with remarkable rapidity, about 2,000 feet being placed by one pipe layer and helper a day.

Approximately, the Bell Telephone Co.'s conduit consists of

The Telephone Company enjoys the distinction of having outdistanced all other wire using companies in the city, in point of time of completion of its underground work.

A method, thoroughly practical and effective of results was that adopted for pulling in the large 120 pair cables used in the street conduits. It consisted in using steam in place of the old turn-stile method as motive power for drawing the cables through the ducts. A small 3½ h. p. horizontal engine and capstan was mounted on a low wagon. Through suitable gear attachment the capstan was made to revolve and wind up a rope, one end of which was manipulated by a man and the other end securely fastened to the cable to be drawn through. The accompanying sketch illustrates the relative positions of cable reel, engine, capstan, and two manholes. In this manner, a speed of 25 feet of cable per minute was easily attained. The rapidity of execution of the work was in part due to this contrivance.

Simultaneous with the outdoor construction, a very active condition of affairs prevailed in the various other departments of the Telephone Company. Plans were drawn up and negotiations entered into with the Western Electric Company of Chicago, for



REAR OF MAIN SWITCHBOARD.

600,000 feet of cable capacity. The general size of manhole is 5 feet by 5 feet by 5 feet with 9-inch brick walls, concrete bottoms, 6-inch clay tile sewer with ¾-S iron trap, and covers grated where necessary. The roof is 10 inches concrete, with rectangular opening for 24-inch by 30-inch self-locking cast steel cover, either solid or ventilated pattern, provided with dirt pans beneath. A number of concrete manholes were also used west of 17th street. The total number of manholes is approximately 600. The largest of these is the main vault under the street on the west side of the Telephone Building. Here on the north and south walls terminate the conduits from the four ends of the city, the south wall containing the 25 ducts of the main line running south, while the runs leading east, north and west, with a total of 86 ducts, are in three sets of ducts, four ducts to the layer, each set completely encased in concrete and separated by one foot of concrete from the adjoining one. The main vault is 12½ feet by 24 feet by 8 feet, with 17-inch brick walls, a 1-inch air space being left on the inside course to render the manhole moisture proof. The roof is 17 inches concrete, supported by 12-inch steel I-beams.

a colossal switchboard of the common battery, multiple branch terminal type, for the new main exchange. On the 15th of November the switchboard arrived, and immediately the work of "wiring up" was begun. Through skilful executive management all of the 4,000 subscribers' positions were completely wired in every detail in the remarkably brief time of two months, for on the 16th of January, at 2 a. m., the first public message was sent through the exchange, thus inaugurating the new metallic system and making the underground telephone service in St. Louis an undisputed reality.

The entire six-story building at the southeast corner of 10th and Olive streets, with the exception of the ground floor and an office on the second floor is given up to the various departments and new main exchange of the Bell Telephone Company of Missouri.

Entering the main vault are forty-two 120-pair lead covered cables, supported on vertical standards, with brackets suitably arranged for curving the heavy cables into the basement on their run to the cable shaft. At the entrance to the shaft they are corniced up and take a vertical course to the fourth floor, ter-

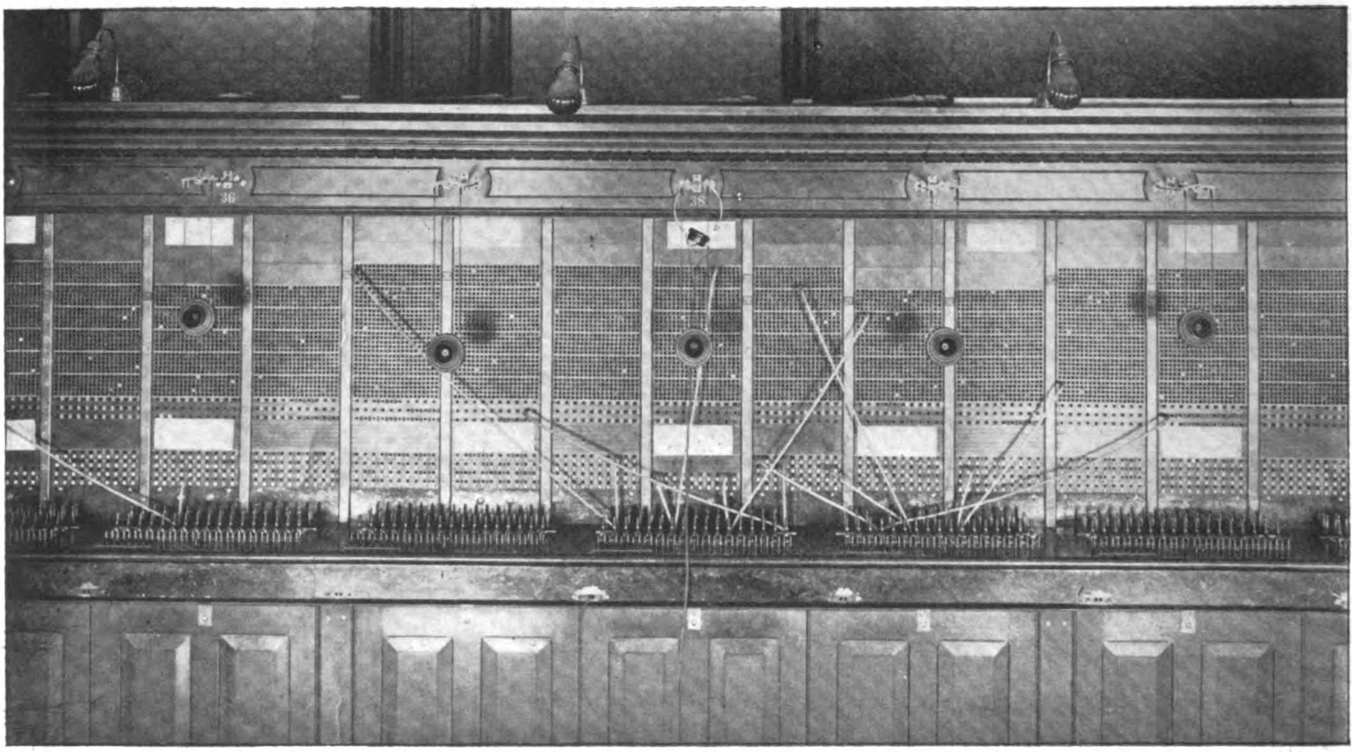
minating on the horizontal side of the main distributing frame. As shown by the view of this side of the board, the 240 wires in each of the 42 cables are "fanned out" and soldered to clips arranged horizontally, along the board, and numbered for convenience, with respect to the cable to which they belong. On the opposite side the main distributing frame is arranged in vertical strips and each subscriber located according to the number assigned to him at the operators' switchboard. Connecting the horizontal with the vertical side are the cross-connecting wires, called "jumpers."

A very important feature of the main distributing board is the precautionary means adopted for protection against the action of lightning and high tension currents due to a cross on the line. The device employed to protect the operator and the switchboard apparatus against the effect of lightning, consists of two carbon plates insulated from each other by a fine strip of mica, one of the plates containing a small cavity filled with fusible metal and grounded. The instant a flash of lightning passes over the wires the arc jumps across the plates and passes to ground through the grounded carbon, thus diverting the course of danger from the switchboard. The sneak current protector, intended for cases of accidental cross on a subscriber's line, with an electric lighting or power circuit, consists of a small coil of German silver wire wound on a hollow brass spool. A short metal rod passes through the hole in the spool and is held in place by a drop of fusible alloy, the whole mounted in a small fibre case. This contrivance is supported between two springs. When a current of abnormal strength flows through the circuit, the wire on heating the spool melts the metal, and releasing the pin, grounds the line, thereby opening up the line in the exchange. In this way danger is averted which might otherwise cause havoc in the exchange. If the cross remains on, the fuse at the cable terminal is blown and prevents damage to the cable itself.

At the main distributing board all changes are made due to the removal of instruments, changes in location of subscribers and new connections. From the vertical side of the frame the wires pass in cables to the intermediate distributing frame located on the sixth floor. In appearance, this frame is very similar to the one on the fourth floor, with the exception that the protection devices previously referred to, are missing. As its name implies, this frame serves an intermediary connection between the main frame and the swithcboard. Its office is to permit of a rearrangement of lines to any operator's position for the purpose of equalizing the calls received over her lines. In this way it is a simple matter at any time to balance the amount of work shared by the operators. This is naturally of prime importance, as it minimizes the time required for connection between subscribers.

From the horizontal side of the intermediate board the wires pass to the multiple jacks and at this point are also connected by jumper wires with the vertical side, to the answering jacks, line and cut-off relays.

The main switchboard, which embodies principles and improvements of the most modern and advanced type, consists of 19 sections, with three operators' positions at each section. Finished in mahogany, it stands about six feet high, four feet wide, and presents an overall length of nearly 115 feet. Its construction is based on the multiple, common battery, branch terminal, metallic system. It is at present wired for 4,000 subscribers' circuits, and is capable of accommodating an ultimate capacity of 5,600 circuits. Two and one-third sections are reserved for incoming trunks from the various branch exchanges, located in the different districts of the city. One section, at the north end of the board, is set aside for all message-rate subscribers, whose calls are recorded and their quarterly rates determined accordingly.



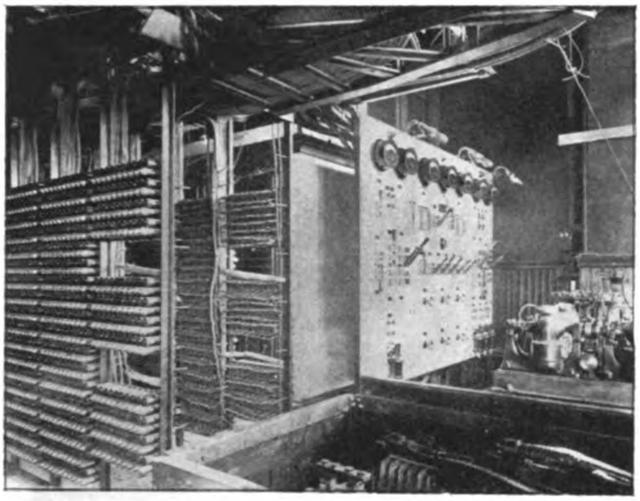
SECTION OF SWITCHBOARD, SHOWING CONNECTIONS SET UP.

As implied by the term "multiple," all the subscribers' lines are multipled in each of the sections of the board. Each operator, although occupying one-third of a section, has a third of a section to the left and a third to the right at her disposal; in this manner having within reach one complete section. As all the subscribers' lines terminate in every section, each operator can readily complete a connection without transferring to another operator.

In addition to the 4,000 calling jacks, there are on the lower tier of the switchboard, as illustrated in the view, 260 answering jacks, appearing only in that particular section and representing the set of subscribers' lines over which the three operators receive their calls.

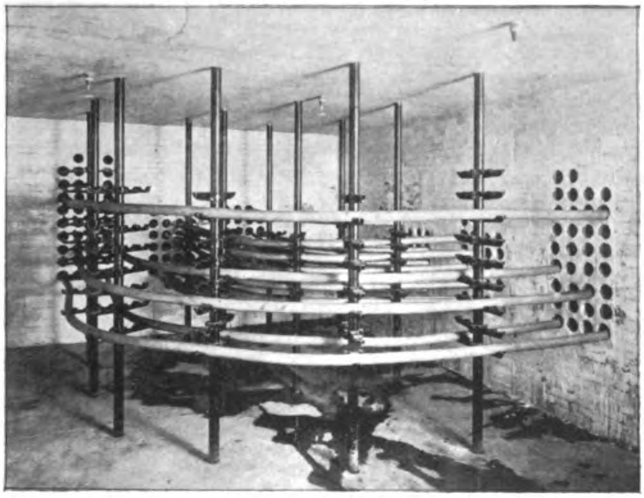
The most novel and striking feature of the switchboard is the automatic arrangement for signalling the operator when a connection is desired. The device consists in the use of miniature electric lamps controlled by relays and suitable resistances, and placed directly beneath the spring jack corresponding to a calling subscriber. Upon the glow of such lights and a larger pilot lamp in front of the operator to attract attention, it is at once known what subscriber has removed his telephone from the hook and desires a connection. On a horizontal keyboard below the jacks just referred to, is a double row of plugs at the ope-

rator's command, the rear set intended for insertion into the answering jacks, the front set being only used to connect with the calling jacks. Corresponding and connected with the two sets of plugs are a double row of miniature cord lamps, whose office is to indicate when the parties have ended their conversation. The keyboard is so constructed as to admit of party



RELAYS, GENERATORS AND POWER SWITCHBOARD.

line service, where two subscribers are connected on the same circuit, one subscriber's signalling apparatus on each side. Each operator's position is equipped with ringing and listening keys corresponding to the plugs at her command. In addition to the possibility of reaching every subscriber in the exchange, each operator is provided with facilities for connecting with branch exchange subscribers over trunk lines. The operation of completing a connection is comparatively simple. A subscriber, on removing his telephone from the hook, preparatory to calling up another subscriber, indicates this fact by the simultaneous glow of the lamp corresponding to his line in the exchange. The operator immediately inserts an answering plug in the jack above the lamp, thus extinguishing it, and on throwing over the listening key opposite the plug, communicates with the subscriber and inquires "what number" is desired. Upon receipt of this, the operator touches the ring of the jack with



MAIN VAULT.—LOOKING NORTH, SHOWING 85 DUCTS.

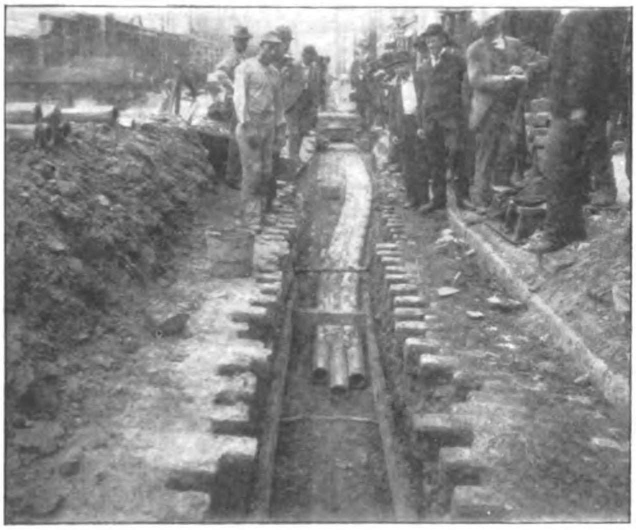
the tip of the calling plug, and if the line is busy it is indicated by a click in the operator's head telephone, but if clear no click is received and a calling plug is inserted into the multiple jack of the designated number and the called subscriber signalled by ringing his bell with the proper ringing key. When conversation between subscribers has ended and the receivers are replaced on the hooks, the little miniature lamps connected with the cords of the corresponding plugs, and which have been dark during the conversation, now flare up, indicating the disconnect signal to the operator. In general, while the lines are connected, it is evident that when the receivers are off the hook the cord lamps are dark, and when replaced the lamps are bright. The large pilot lamp before each operator, and which simultaneously responds with the small lamps below the answering jacks, when a call is received, are duplicated on the chief operator's tables. In this manner, it is possible to know the exact condition of affairs at any operator's position on the entire board. By observing the various lamps at her board, the chief operator can tell at a glance how promptly calls are being answered and how busy any section or the entire board may be, at any instant.

A toll board, for the outlying stations in Missouri and Illi-

SIX LAYERS HOLLOW BRICK TILE ENTERING MANHOLE.

nois connected with the system, is another adjunct to the switchboard equipment. On the fourth floor the wire chief's table plays an important part in the working of the Exchange. For it is here that all the subscribers circuits are systematically tested at regular intervals, complaints registered and orders issued for immediate repairs.

The back of the main switchboard, as illustrated in the cut, presents a fair idea of the magnitude of wiring required to complete the circuits of the lines entering the main office. Contrary to off-hand impression, it is a notable fact that the cost per subscriber's position increases with the increase in the number of subscribers in an exchange, owing to the additional number of times the line must be multipled throughout the board in order to appear before each operator. It may be possible to

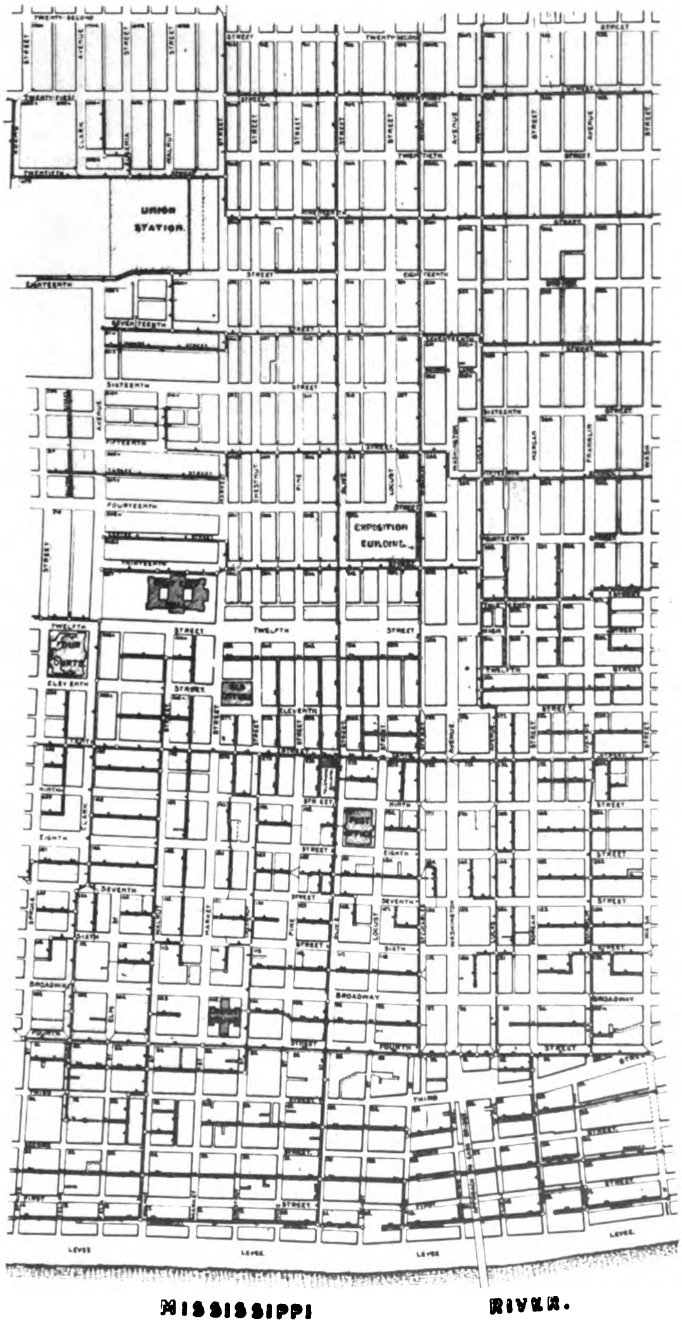


HOLLOW BRICK TILE, TWO LAYERS "FANNED OUT" TO MAKE ONE OVER EIGHTH STREET TUNNEL.

realize the outlay of wire required in the installation of such an exchange, when it is stated that there are five million six thousand feet of wire in the straightaway cables, and nine million two hundred and eighteen thousand feet of wires in the

relays and other coils. The number of soldered connections between the terminals of cables on the main distributing board and the operators' switchboard is estimated to be at least one-half million.

Most of the 120 pair cable used in the conduits was furnished by the Standard Underground Cable Company of Pittsburg, and the remainder by the Western Electric Company of Chicago. The 240 conductors are of hard drawn copper, No. 19 B. & S. gauge, paper insulated and twisted in pairs, the whole encased in a heavy lead sheath. Before acceptance, each cable was tested for capacity not to exceed .08 microfarads per mile,

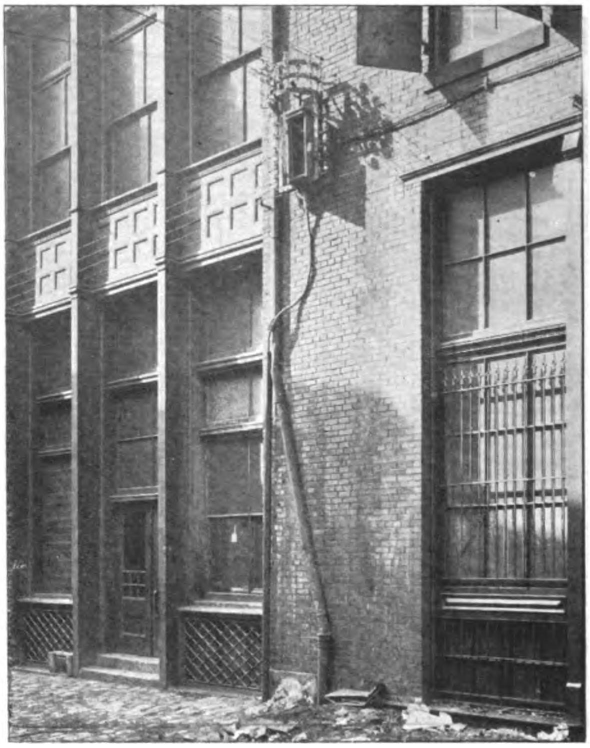


MAP OF UNDERGROUND DISTRICT, ST. LOUIS, MO.

and the insulation resistance not to fall below 500 megohms per mile.

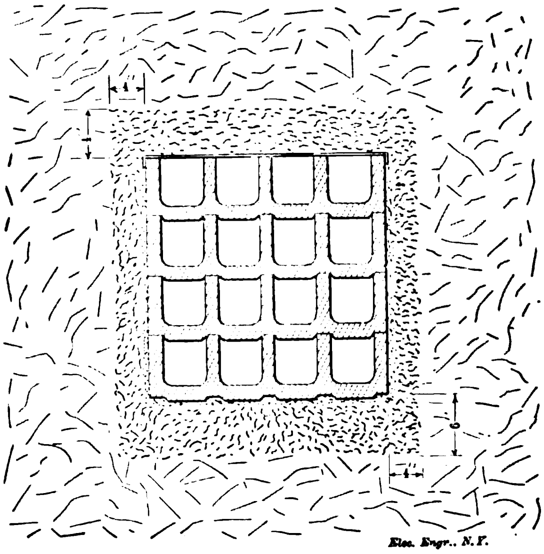
All single pair lead covered cable, furnished by the American Electrical Works of Providence, Rhode Island, was of No. 20 B. & S. gauge, with double cotton insulation and twisted. All of this cable was tested for insulation with a pressure of 2,000 volts and an insulation resistance not to fall below 250 megohms per mile.

Contrary to the Law system, where the local batteries are required at the subscribers' instruments, thus necessitating a great deal of inspection and renewal, the most modern and simplified form of battery transmission concentrates the electrical energy at a central point for distribution. In the battery room, which is the heart and lungs of the telephone exchange, large sets of storage batteries are installed. Eight large cells of style



CABLE BOX IN ALLEY.—UNDERGROUND CABLE TERMINATION AND DISTRIBUTION OF CIRCUITS OVERHEAD.

31-G Chloride Accumulator, feed the miniature 8-volt cord signal lamps. While one set of four cells is being discharged the other set of four is being charged from the motor generators. The normal useful capacity of these cells is 3,000 ampere hours. Ten cells of 11-G type are used for talking current over the lines.

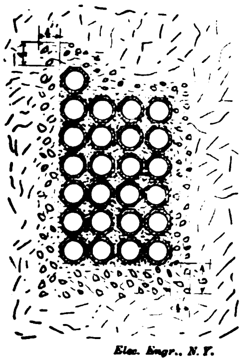


MULTIPLE DUCT TILE CONDUIT.

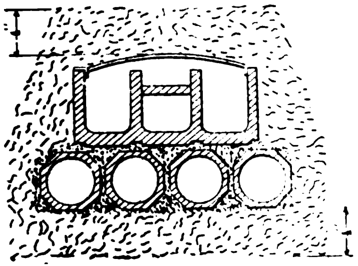
They are charged at the rate of 50 amperes and 24 volts. The discharge is at 20 volts, while the current necessarily varies, ranging from 10 to 50 amps. In addition to these, there is a set of six cells of style 11-F to supply current for the transmitters and line signals.

In the power room adjoining, are the motor generators, including the ringing and "busy" signal machines manufactured by the Western Electric Company. Current for ringing and

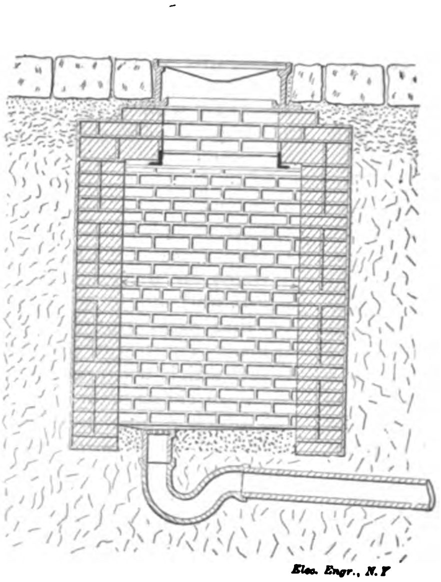
signalling is furnished from the same machine. The ringing current is supplied from the alternating side of the generator, while an ingenious device is attached and produces a note of high pitch, which, by a system of gearing, is interrupted at regular intervals, so that when the operator inserts the answer-

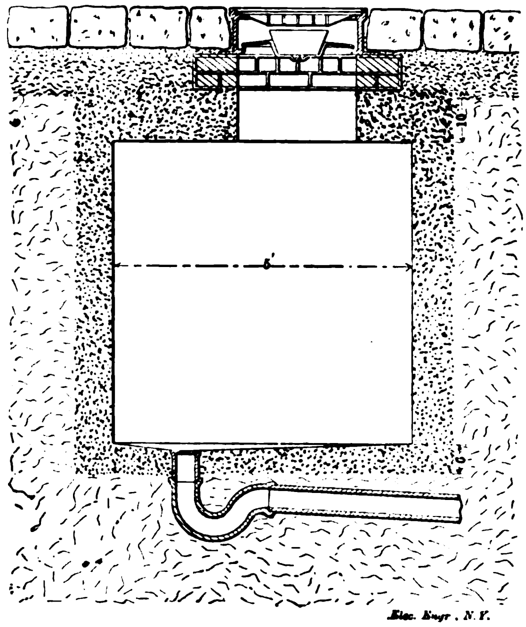


3¾-INCH HOLLOW BRICK TILE CONDUIT.



DISTRIBUTING DUCT TILE CONDUIT LAID ON HOLLOW BRICK TILE.



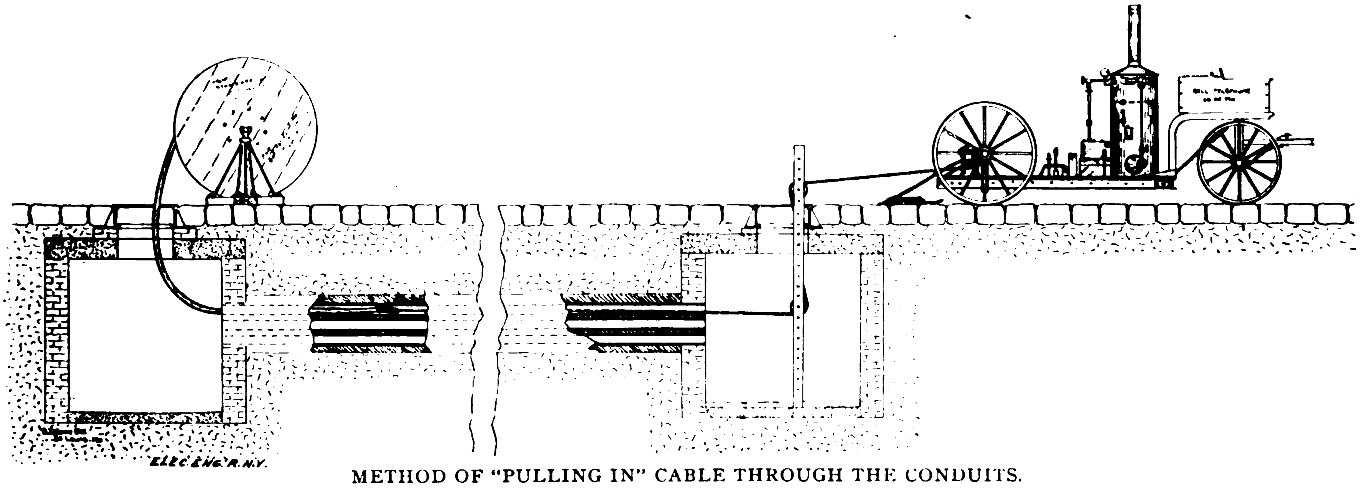


TYPICAL FORMS OF MANHOLE CONSTRUCTION.

ing plug into special jacks, reserved for the purpose, a series of interrupted "toots" is transmitted to the subscriber, indicating that the line desired is busy.

Located in a convenient position, the power switchboard, of polished white marble, is equipped with the necessary switches for charging and discharging the batteries, in addition to a complete set of volt meters, ammeters and fuses, all of Western Electric construction.

During the day, current for the motor generators, which charge the batteries, is furnished by the local plant in the basement of the building. This consists of a 10 h. p. horizontal Ball engine, direct connected to a direct current machine, capable of an output of 50 amperes at 220 volts. At night or in cases of emergency, current is tapped from the mains of the Missouri Edison Electric Company or received over a feeder directly connected with the local plant of the branch exchange



METHOD OF "PULLING IN" CABLE THROUGH THE CONDUITS.

in South St. Louis. The motor generators receive the current at a pressure of 220 volts. This is transformed by a secondary winding to a voltage adapted to the capacity of the storage batteries, which they charge. Either of the two large machines charge the ten cells used for talking current at 24 volts and 60 amperes. The third machine used for the 8-volt battery, is capable of delivering 150 amperes at 12 volts. These batteries furnish current for the cord signal lamps. A fourth machine charges at different times, two sets of batteries, a 2-volt and a 4-volt, respectively, the former used for the operators' transmitters, the latter for the line signal lamps. The machine can deliver at its secondary 60 amperes at 6 volts. The ringing and busy back machines, previously mentioned, complete the list of generators. The units are so selected that in case of injury to any one machine resulting from a burnt out armature or otherwise the operation of the exchange is not in the least affected.

It is needless to observe that with metallic service installed, it is possible for a subscriber, without leaving his office, to communicate with a person in any city in the United States where long distance service has been established. Thus it is a common occurrence to send or receive messages to and from Chicago, New York or Boston. In fact the people from the State of Maine may converse with their friends in Nebraska with the same facility and clearness as experienced over a local connection.

A ventilating and heating system of the most modern design is to be shortly installed. The air will be sprayed, dried and heated or cooled before being forced into the operating room, thus offering the most favorable conditions for the operator's prompt and efficient execution of her duties.

The work of removing the ærial wires and cables, poles and cross-arms, so long a menace to public safety, yet a necessary

evil in the business district, is progressing rapidly, and in the near future St. Louis will enjoy the benefits and all that it implies, of a complete, modern conduit system and underground service.

Practical Features of Telephone Work—VI.

BY A. E. DOBBS.

LAYING out routes for pole lines will often require a great deal of diplomacy, as a good amount of purely captious opposition will have to be met and overcome. People living on streets where there are already perhaps one or two pole lines, can hardly be blamed for not wanting to see another one. Some day there may be a law compelling all companies occupying the streets, to agree on the joint use of a single pole line. This scheme is practicable, and would be less troublesome and expensive, than the present cumbersome and unsightly methods. Meanwhile each company has to build its own pole lines, and the fact that the company has a franchise from the town council or street commissioners does not give it the right ot way if property owners object, for city officials often give away what does not belong to them, but the fact that the company holds a franchise for all streets and alleys, can often be used as a successful argument or bluff. It will often be found that the best and cheapest plan is to buy the right of way with the necessary tree trimming privileges. But after all, the point to be gained should be to soothe rather than irritate, for some of these people may be able to throw a great deal of influence for or against the company at some future time, and the new company will need all its friends for they will have fighting enough with the other company.

If possible, the main streets should be avoided; take side streets and alleys. It may take a few more poles, but in nine cases out of ten it will pay. Take for example the map of a town shown in Fig. 16. By following the dots it will be seen

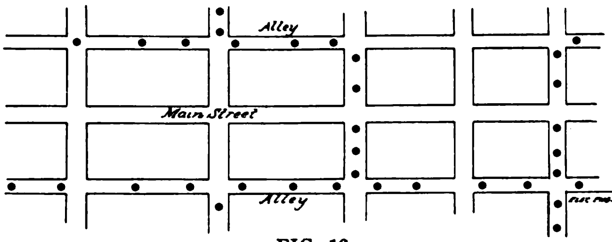


FIG. 16.

that the line almost avoids the main street shown in the centre, and comes into all buildings from the back. It seems to take a few more poles, but in the alleys no obstructions worth mentioning were met, nor paving to be done; no trees in the way worth mentioning, and no objections from property owners; while smaller and cheaper poles were used than would have been possible on the main street.

Again, by going into the alleys the company really covered three streets, so that after all the cost was no greater than to have covered the same territory from the main streets.

Never set a pole in front of a man's house or lot if it can be avoided. Choose the line between two lots, and much objection will be silenced. Poles intended to carry three or four arms should be planted as nearly as possible, 130 feet apart, as they will hold the wires in better shape, and avoid much trouble.

A very good plan used for local distribution at Albany, N. Y., in streets where shade-trees made a pole line an impossibility, was to stretch a No. 6 wire across the street from tree to tree, about 20 feet from the ground to which were tied from 10 to 30 porcelain knobs, at about 12 inches apart, over the centre of the street. The line wires were then drawn through the centre holes of the knobs, and distributed where needed. The span wires were from 100 to 125 feet apart.

POLES.

Cedar or chestnut poles are by all odds better than any others to be found in the Northern States, while in some sections spruce, yellow pine or cypress are the only kind to be had at reasonable cost. In some parts of the country sawed poles are used a great deal, but they do not last as long as the round timber. In some places poles can be procured nearby, in which case it is generally better to cut them in midwinter, for there is a tradition among farmers that they last longer than if cut at any other time, as the sap is then out.

If the plant is being built on a permanent basis, no poles smaller than six inches at the top should ever be used if possible to avoid it, and accept a six inch top only on condition that the pole is stocky and solid otherwise. We have known of contractors using poles as small as four inches at the top, but that does not make it good practice. The part of the pole that goes into the ground, should be treated in some way to prevent decay, either with tar, asphaltum or creosote. Even an oil paint is better than nothing at all. The ends especially should be saturated with it, to prevent the absorption of moisture. In some parts of the West they are put over a fire, or kerosene is poured over them and they are charred at the butts, which is said to double the life of them in the ground. Some companies boil both poles and arms in raw oil or creosote, putting them in a vat for this purpose, which should fill the pores pretty thoroughly, and improve the insulation as well.

Gains for the arms should not be cut more than an inch in depth, and should be soaked with paint before the arms are put on, thus preventing a great deal of dampness and decay at these spots. The top of the pole should also be well saturated with paint, which will prevent warping and splitting. The two top arms on chestnut or spruce poles should be secured by a bolt, for which a hole must be bored clear through both arm and pole, and the pressure relieved by a two inch washer, or better still a plate of 3-12 iron, two inches square. If lag screws are used they are liable to split the pole. Where lags are used on cedar, or green chestnut, they can be driven home, but in seasoned chestnut or other kinds of wood they had best be turned up the last inch with a wrench. Of course all 10-pin arms at least will be braced. The most common brace for this size is 22 × 1 1-4 × 1-8 or 3-16. Standard 10-pin crossarms are of two sizes, known as the short and long arm; one most commonly used in exchange work being 8 feet 6 inches in length. Specifications as follows:

Dimensions	8 feet 6 inches × 3 inches × 4¼ inches.
Distance between two middle pins (centre).........	16 inches.
Distance between all other pins (centre)............	10 inches
Distance of pins from each end (centre)...........	3 inches.
Diameter of pins...........	1¼ inches.
Length of pin to shoulder (lower part).....	3⅞ to 4 inches.
Length of pin from shoulder to top........	4⅛ to 4½ inches.
Total length of pin	8 inches.
Length of thread	2⅛ inches.
Number of threads to the inch....................	5
Depth of threads	⅛ inch.

Specifications for long arm:

Dimensions....... ......10 feet × 4¼ inches × 3¼	inches.
Distance between centre pins	16 inches.
Distance between all other pins....................	12 inches.

Other details the same as for the short arm, except that sometimes the pins are 1½ inches instead of 1¼ inches, but we do not think this is necessary, if the pin is made according to the specification given above. Iron pins are being used a great deal. The best wooden pins are locust, with chestnut second, and oak third; this latter not having the lasting qualities of the first named. The best arms are made of yellow pine, or creosoted white pine. It is also advisable that pins should be well oiled.

INSULATORS.

For wire not heavier than No. 9, what is known as the pony is the cheapest form and as good as any for telephone work. One style of insulator has two grooves and this is often an advantage, for on corners the wire can be dropped down to the second groove, bringing the strain nearer the base of the pin, while on junction poles the tops can be lashed together, while the line pulls off from the lower groove, though a double glass with a skirt between the groove is better for this work.

The double groove glass also makes a very fair transposition glass as it will interpose about 1½ inches between the two wires and while this does not afford the highest insulation between the wires, there is a growing impression among telephone men, that a slight leak at regular intervals is an advantage to the line rather than otherwise. On country lines it is perhaps advisable to use heavier glass—that known as the heavy pony being about the thing—because a country line is never inspected as long as it will work, and the light pony insulators break too easily, and are liable to remain broken for some time, without being observed.

ELECTRIC LIGHTING

Statistics on English Electric Lighting Plants—II.

BY CLAUD P. D'OYLY.

TAKING a cursory glance at Table 1 in the last article, it would seem that direct current plants are more profitable to operate than alternating plants; this is because the business is congested, and the route of the mains is well built up; you do not find as you leave the city the houses getting fewer and fewer per block, until you come to the outskirts, where there is only one house every two or three squares, as we have here in America. Generally, the city is built up thickly, and the houses end abruptly at the edge of some estate, which very likely cannot be sold or built on.

The revenue per eight candle power lamp averages in Great Britain $1.72 for d. c. stations, and $1.56 for alternating current plants. In London the different companies average $2.78 per eight candle power lamp per annum. Some of the engineers of direct current stations took the trouble to make estimates of the amount of money expended on service copper per eight candle power lamp; but this estimate is very hard to make with any degree of accuracy, but was computed on the amount expended for mains and the cost of installing them. But their estimates cannot be considered very accurate, as in some cases it is impossible to separate the cost of the high voltage arc lamp circuits which are put in at the same time in the same conduits; and, moreover, some conduits are laid for eight circuits and only contain one or two circuits; and of course the total expense of this conduit should not be charged to the present installation. On five d. c. plants with 165,000 eight candle power lamps installed, which plants sold 1,800,000 k. w. h., and on which the revenue was $300,000 in 1897, the copper cost per lamp for service wire averaged only $8.52, from which it will be readily seen that direct current would be hard to beat in copper cost. The Board of Trade requires a special analytical report of all electric lighting companies, and this requires constant bookkeeping and analytical work; and as this is in the nature of a public document, all electric light plant managers and engineers were willing to show this report as far as it had been brought up to date, and would take much trouble to make things perfectly clear. This report requires that every detail shall be separately worked out by itself, showing every expenditure and what proportion it is to the gross expenditure, and how much it amounts to per k. w. h.

Table 2 is a partial list of plants owned by municipal authorities, and gives the cost of the plant per kilowatt and per eight candle power lamp.

Table 3 is a partial list of plants owned by private companies, and gives the same figures in a general way, and shows the amount which has been saved by the municipality using ground they already owned and making use of boilers and employés of the gas and water works.

As showing the constant growth of the best installed plants, I have taken two plants in a residence part of London, where the gas competition is the keenest and the price is the lowest.

NOTTING HILL ELECTRIC LIGHTING CO.

Year.	Houses Conn'd.	Lamps Conn'd.	Units sold.	Revenue.	Expense.		Profit and loss.	Div.
1891	77	6,056	30,162	$8,115	$10,800	Loss	$2,685	..
1892	124	9,438	75,667	17,600	16,500	Prof.	1,100	..
1893	173	12,135	107,580	21,560	20,560	"	1.000	..
1894	234	15,669	130,266	25,580	15,100	"	10,480	1%
1895	307	20,307	182,327	34,600	18,500	"	16,100	2
1896	396	25,716	230,787	48,000	19,080	"	23,920	4
1897	571	33,000	354,969	58,000	23,800	"	34,200	6

HOUSE TO HOUSE ELECTRIC SUPPLY CO.

Year.	No. lamps.	Houses Conn'd.	Gross Receipts.	Expense.	Net receipts.
1890	16,665	248	$25,050	$23,100	$1,950
1891	19,388	373	41,600	30,100	11,500
1892	23,700	471	53,400	39,000	14,400
1893	28,429	599	50,300	39,000	21,300
1894	35,858	755	68,500	37,000	31,500
1895	44,162	932	76,700	42,300	34,400
1896	52,265	1,164	87,200	42,000	45,200
1897	66,364	1,416	104,000	43,500	60,500

These are both companies furnishing light in residential districts, and it will be noticed that whereas the increase is slow, it is sure, and this accounts for the healthy condition of the manufacturing business, as all these new customers require meters and cut-outs and wiring. In the case of the House to House Company, the average lights per customer has been reduced from 67 to 47, showing that at first the electric light was looked upon as a luxury, and only the very richest people had their houses wired; but later, as the cost was demonstrated, people of smaller means came in and demanded current; in 1890 the average bill was $100 per customer per annum, and in 1897 it was $73 per customer per annum.

In the Notting Hill Company the number of lamps per customer averaged 91 in 1891, and has worked down to 57 at the present time; but the revenue per customer has remained about the same—a trifle over $100; but the price has been reduced from 26 cents per k. w. h. to 16 cents. They seem to have cultivated a taste for electric light and to have done it profitably.

TABLE II.—LOCAL AUTHORITIES.

Towns.	Kilowatt capacity end of year.	Capital outlay per kilowatt.	Capital outlay per lamp.
Aberdeen	430	$350	$9.35
St. Pancras	1,174	480	12.30
Belfast	283	515	13.90
Bradford	1,393	255	9.25
Brighton	1,210	625	10.20
Burnley	330	370	12.20
Dewsbury	250	410	24.10
Dundee	560	315	10.80
Glasgow	1,700	385	8.30
Hull	638	355	9.05
Manchester	3,240	385	12.15
Nottingham	470	570	17.35
Oldham	432	365	13.35
Lancaster	240	450	16.85

Average, $418 per kilowatt and $13.25 per light.

To show the rapid advance of the lighting, it is only necessary to state that some plants have already changed and put on 220-volt lamps on their circuits, and in many more would like to, but are afraid. "It looks too much like going back to the old days of 1883," a prominent engineer remarked to me, "when no one expressed surprise when electrical apparatus smoked or got so hot it could not be touched with the hand; when 220-volt lamps are installed, and trouble comes, the cut-out and socket are blown into unrecognizable pieces." He said that the sudden explosion which blows the covers of cut-outs to pieces is caused by the sudden expansion of the contained air, and must be obviated by using a large cover with perforations. We prefer a cartridge fuse here, with no chance for air to enter or without any chance for the hot air to escape. They approve of the idea of putting a cement plaster around the fuse, as it keeps down the temperature and minimizes the effect of the arc. The increase of business in some cases being 50 per cent. per annum for three years in succession is a very serious matter for the borough engineer who laid out the plans on a basis of the demand for twenty years, especially as the companies have been financed and the sinking fund has been arranged on that basis. A company which sells as Birmingham did, in 1895 496,000 k. w. h., in 1896 756,000 k. w. h. and in 1897 1,133,000 k. w. h., is quite puzzling, as besides having to settle with the stockholders, there is the Board of City Councilmen and the Government Board of Trade Inspector. The corporation is bargaining to gain control of this company, but as this

TABLE III.—INCORPORATED COMPANIES.

Towns.	Kilowatt capacity.	Capital outlay per kilowatt.	Capital outlay per lamp.
Charing Cross	1,050	$1,040	$21.30
Kensington	1,780	575	10.85
Nottingham	330	1,270	20.35
St. James	2,100	565	12.95
Westminster	3,783	590	10.50
Birmingham	1,100	615	18.65
Hove	440	650	15.60
Kelvinside	180	925	25.30
Northampton	200	510	16.75
Norwich	545	490	13.80
Pontypool	68	480	10.15
Preston	602	555	21.90
Richmond	290	675	35.70
Southampton	303	315	13.90
Liverpool	2,200	600	19.30

Average, $655 per kilowatt and $17.80 per lamp.

is the first year a 5 per cent. dividend has been declared on the common shares, 1,000,000 dollars, and the stockholders have previously foregone dividends on account of the future prospects, it is a hard matter to arrange equitably.

Sheffield is a plant very well situated and very well managed, which pays this year 12½ per cent. to its stockholders; it has been in operation five full years and the revenue accounts are as follows:

1893	$17,777
1894	24,247
1895	34,675
1896	56,340
1897	71,090

Now the corporation has given notice of its intention to buy the company out and has negotiated for about a year, so as to arrange means of payment and terms. The last offer is to give each holder of stock, $1,100 of corporation, 2½ per cent. debentures for each 500 dollar share, and to pay stockholders such sum as would be equivalent to a dividend of 5 per cent. per annum on all the money invested. The corporation borrows the money at 2½ per cent., and buys the plant on a 5½ per cent. basis, although it is paying 12½ per cent. and is growing. People are conservative and take time to arrive at a decision to make a change in their lighting arrangements, but time is all it requires; there is a great natural growth, and you do not often hear of companies doing free wiring to get customers, although there is a slot meter company which seems to be prospering through a slight discount they get from the customers' bills; but it seems like rather a small economy to admit a middleman into that position, considering the large investment the company has in plant and mains. It seems rather absurd that a company which has invested a sum of $400 per k. w. h. in the stations, or $12 per eight candle power lamp installed, should allow a concern to retail their current.

A bill has been presented to Parliament, giving the electric companies the right to buy property adjoining their plants; it seems to be thought that property which is required for increase of the plant attains immense value in the eyes of the holder. The bill states that as the companies have statutory obligations to fulfil for the convenience of the public, they should have the same rights steam railroads and electric railroads have, to enable them to perform their obligations. There are, of course, two sides to the question, but if the act becomes a law, perhaps if an electric light plant is located next to your house, it will be best to move instanter, and not put up with noise and other inconveniences necessary to a manufacturing establishment, as you may be forced out any time the company chooses, and you are not likely to get such pay for your property as will reimburse you for the inconveniences; you will merely be bought out on a basis of rental for 33 years. The lack of enterprise exhibited in the matter of installing plants is not so surprising, if we look at the matter from the investors' standpoint, and it accounts for the fact that the municipalities have about one-half the plants, and the other half are promoted and owned by the same clique who have close relations with some manufacturers. No water is allowed in the stock, and the chances are that for some years there will be no dividends, and after that, when the dividends are large, the municipality comes in and buys the enterprise up—not on the basis of the present earnings and future prospects, but on the basis of what money has been put into the plant. There is not the same inducement to the promoter as there is when a man can issue unlimited stock, and bonds as long as he can negotiate them. The franchise is looked upon as a valuable asset of the city, lent to the company operating the electric light station, which asset will be called for at some future time; and it makes the matter at any stage rather unsettled, as improvements to take place in a series of years cannot very well be undertaken unless the field of operation is unlimited, and arrangements as to charges for current cannot be made for any length of time ahead. With street railways it is even worse, and the bargains made in some cases by the city are wonderful, and apparently the only way the company leasing from the city can make more than 3½ per cent. per annum is in the amount which can be made in putting in the equipments and trolley lines.

PITTSBURG, PA.—The Allegheny County Light Co. has voted to increase its capital stock from $1,500,000 to $2,500,000, in order to develop its business.

MUNICIPAL AFFAIRS

Municipal Electric Lighting.[1]—IX.

BY PROF. JOHN R. COMMONS.

FOSTER'S ESTIMATES EXAGGERATED.

WHEN, now, we proceed to compare the cost of public with private lighting we see how greatly exaggerated is the estimate of Mr. Foster. He indeed does not make computations for lost taxes, but since this item cannot exceed 1 per cent., and probably should be excluded altogether, and since insurance is included in operating expenses of all the small plants which he examined, his rate of 7½ per cent. for depreciation is fully double a reasonable rate. Mr. Parsons, who makes fixed charges 5 per cent. to cover depreciation, insurance and lost taxes is certainly sufficiently liberal to the opponents of municipal ownership.

The exaggerations of Foster's estimates appear yet more clearly when he compares directly the costs under public ownership with the costs under private ownership. He compares the total cost per lamp hour of the fourteen cities of his investigation which had street lighting plants alone with fourteen other cities having private plants.[2] His averages apparently show that in municipal plants the cost to the city is 1.86 cents higher per hour than in the private plants. But the table is worthless both in method and in fact. 1. Every statistician knows that in getting averages extreme and exceptional cases should be omitted. In these fourteen municipal plants there are three exceptional cases. Alameda, Cal., where he himself says the high cost "throws doubt on the accuracy of the figures;" Fairfield, Ia., a diminutive plant with but fourteen arcs and no commercial lighting; and Anderson, Ind., a plant using natural gas. Two of these cities have exceptionally high costs and one has exceptionally low costs. Excluding them, the average would be 4.13 instead of 4.44 cents per lamp hour. 2. His rate of interest for municipal plants is six per cent. which is fifty per cent. above the correct rate. 3. This rate is computed upon the total cost of plant to date, including new construction paid out of taxes. It should be computed only on the outstanding debt. 4. His rate of depreciation is seven and one-half per cent. which is one hundred per cent. above the true rate. 5. He selects fourteen private plants for comparison which he says are similarly situated (giving no names). But this is impossible, for private plants have always commercial lighting as well as public lighting, and they usually give a lower rate to the city than to private consumers. They can well afford to do so, for thus they keep their hold on the private citizens. The usual method of judging the companies by their rates to the city overlooks the way in which they are depriving the people at large of the advantages of electricity. In Table XI. Mr. Foster selects sixteen private plants the average cost of whose lights to the cities is $.086 per kilowatt hour ($.041 per lamp hour), instead of $.0358 per lamp hour.

Taking the first, second and fourth of these criticisms into account and omitting the others I have drawn up the following table, using the data supplied by Foster himself; and by the side of the estimates which he has made for the fourteen city plants in question I have placed three trial columns showing what would be the cost per lamp hour: first, with interest at four per cent. (the actual rate), and depreciation at seven and one-half per cent. (his rate); secondly, with interest at four per cent. and depreciation at five per cent.; thirdly, with interest at four per cent. and depreciation at three per cent. I have also estimated again for each of the four columns what would be the true averages if the three exceptional cases were omitted. It will be seen that even with depreciation at seven and one-half per cent., as he claims it should be, the average cost to cities is only $.0351 when exceptions are omitted and interest is put at its true rate of four per cent. By the other estimates it is much lower. Thus while Mr. Foster has been candid, a correction of his inexcusable guesses and mistakes of method demon-

[1] Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec Engr.

[2] See Table XII., columns 1, 3 and 7, which show according to Foster that the average cost per lamp hour in public plants is $.0444 and in private plants $.0358.

strates with his own data the decided superiority of the municipal plants.

TABLE XII.

COMPARATIVE COSTS AT DIFFERENT RATES OF INTEREST AND DEPRECIATION PER LAMP HOUR.

Cities.	2 Rate of Interest given by Officials to Foster.	3 Foster's Estimate. Interest 6 %. Depreciation 7½%.	4 Same with Interest 4 %. Depreciation 7½%.	5 Same with Interest 4 %. Depreciation 5 %.	6 Same with Interest 4 %. Depreciation 3 %.	7 Total Price by Contract with Fourteen Private Plants, names of cities not given.—Foster.
Goshen, Indiana	....	$0.0480	$0.0459	$0.0426	$0.0403	$0.055
Lewiston, Maine	....	.0257	.0246	.0231	.0216	.052
Easton, Pennsylvania	4	.0418 (4 %)	.0413	.0388	.0359	.026
Frederick, Maryland	....	.0319	.0372	.0345	.0323	.055
Fairfield, Iowa (1)	....	.0765	.0712	.0648	.0597	.063
Anderson, Indiana (1)	....	.0150	.0141	.0127	.0120	.035
Little Rock, Arkansas	....	.0503	.0448	.0413	.0385	.032
Marshalltown, Iowa	....	.0226	.0207	.0183	.0162	.038
Alameda, California (1)	5	.1240	.1229	.1145	.1004	.029
Painesville, Ohio	....	.0395	.0392	.0366	.0347	.035
Chicago, Illinois	....	.0430	.0410	.0371	.0337	.032
Elgin, Illinois	5	.0400	.0391	.0372	.0348	.028
West Troy, N. Y.	....	.0241	.0225	.0212	.0199	.033
Bay City, Michigan	....	.0306	.0300	.0279	.0262	.033
Averages		.0444	.0425	.0393	.0361	.0358
Extremes omitted		.0418	.0351	.0326	.0304	....
Candle Power per 1 cent.		484	570	613	658	559

(1) These are omitted under "extremes omitted."

Similar corrections also show that in cities with commercial plants the net cost of public lighting, instead of being $.1105 per kilowatt hour ($.0579 per lamp hour), is only $.0668 per kilowatt hour ($.0319 per lamp hour), and is therefore less than when the city has street lamps alone, and is less than when the city private companies, which Foster adduces, by $.0192 per kilowatt hour ($.0091 per lamp hour), a difference of twenty-two per cent. in favor of the municipal plants. The table is reproduced here with these corrections:

TABLE XIII.

COMPARATIVE ESTIMATES OF NET COST PER KW. OF PUBLIC LIGHTING FOR CITIES HAVING COMMERCIAL PLANTS.

Cities.	Rate of Interest reported by officials to Foster.	Total cost per kw. for total output. Foster.	Net cost per kw. used for city lamps, after deducting commercial income.	Same, with interest 4%, depreciation 7½%.	Same, with interest as given and depreciation 5%.	Total cost by contract with private companies, names not given.—Foster.
Crete, Neb.	..	$ 0.2478	$ 0.2620	$ 0.2439	$ 0.2320	$ 0.115
Chehalis, Wash.	8	.0960	.0918	....	.0687	.077
Luverne, Minn.	7	.0528	.0019	....	—.0214(1)	.061
Dunkirk, N. Y.	..	.0569	.0565	.0546	.0449	.053
Shelbina, Mo.	7	.1324	.1770	....	.0417	.091
Farmville, Va.	6	.0884	.0259	....	.0418	.063
Rock Port, Mo.	6	.0975	.0149	....	—.0063(2)	.046
Hope, Ark.	..	.0758	.0630	.0635	.0507	.078
Arlington, Minn.	..	.1540	.2160	.2036	.1262	.104
Falls City, Neb.	5	.0561	.0011	....	—.0093(3)	.041
Madison, Ga.	6	.1470	.1760	....	.1620	.065
St. Clairsville, O.	5	.0483	.0617	....	.0540	.060
Hannibal, Mo.		.0565	.0734	....	.0585	.123
Quakertown, Pa.	4	.1095	.1870	....	.1701	.163
West Field, N. Y.	4	.0956	.1294	....	.1225	[illegible]
Averages		.1009	.1105	....	.0668	.086
Same in lamp hour, 2000 c. p.		.0642	.0579	....	.0319	.041
Candle power per one cent.		267.	345.	....	627.	488.

(1) Profit, $225. (2) Profit, $160. (3) Profit, $300.

DETROIT AND CHICAGO CONTRASTED.

The foregoing analysis of Mr. Foster's statistics is enough to show that the actual results of municipal lighting are superior to those of private operation. The estimates made in the last two columns of Table II. may be considered as marking the extreme cost of municipal lighting, including, as they do, every reasonable charge, and allowing from two to four per cent. more for fixed charges than the facts really demand. In addition to the preceding discussion, I present the following comparisons of interest:

The municipal plant in Detroit for the year ending June 3, 1897, reports the actual cost of 1,564 arc lamps, including interest, depreciation and lost taxes, at $89.42 per year. There were also 3,064 incandescents, making a total of 1,716 full arcs, on the basis of the kilowatt hours of output. The total cost, including interest, four per cent., and other fixed charges, five per cent., was $171,883.56, equal to $100.16 per arc equivalent. I am convinced that this estimate is too high for Detroit, because the underground construction should bring depreciation below three per cent.; also, the cost of the plant, $714,843.76, is $416.57 per arc equivalent, which is $134.07 in excess of the Allegheny plant ($282.50 per arc equivalent), and probably $200 in excess of the cost in private plants which have commercial lighting. The high cost includes underground construction, built in anticipation of future growth of the city. Taking these into account, the estimate of the Commission at $89.42 is more nearly just.

The municipal plant of Chicago was reported by the city electrician in 1896 as furnishing arc lights at a cost of $96.40 for operation. I am informed by the comptroller that the present city electrician thinks this estimate is incorrect "for the reason that not enough is included for the maintenance of the lights and there is no allowance made for the office expenses. He has made a separation of the charges and added in the amounts which have been omitted, and finds that the lights actually cost the city about $117 per light per year," not including fixed charges. Since July 1, 1897, however, the present electrician figures the average cost per light per month at $7.35, including "a fair proportion of office expenses, all repairs and improvements in stations and circuits and all the operating charges. The estimate of the cost per light per year will not exceed eighty dollars, and he has hopes of making it still lower next year. He does not figure any interest on the money invested. A full 2,000 power electric light is furnished, and reports show that the lights are operated a greater number of hours than any other municipal or private plant from which this city has ever received a report. The cost per hour last month was $.0224." As I have no detailed reports from the Chicago plant, I give below the computations above made for Detroit and Allegheny, together with prices charged by private companies in representative citites:

TABLE XIV.

COMPARISON OF COSTS TO THE CITY FOR STREET LIGHTING.

	No. lamps 2,000 c. p.	No. hours per year.	Cost to city.	Cost per lamp hour.	Candle power for one cent.
Municipal plants.					
Allegheny	1,235	4,007	$73.53	$.0183	1,093
Detroit	1,716	3,791	100.16	.0264	757
Detroit, official	1,564	3,791	89.42	.0236	847
Private plants.					
Pittsburg	1,700	3,650	96.00	.0263	760
Buffalo	2,100	3,650	126.00	.0345	580
Columbus, O	990	2,179	74.50	....	585
Indianapolis, Ind.	1,100	2,179	85.00	....	511
Philadelphia	6,500	4,000	$109 to $146	....	498 to 734
New York	...	4,000	146.00	.0365	548

The municipal plant in Allegheny reports that the operating expenses for 1,037 arc lamps in 1896-7 were $53.55 per lamp, having been $61.24 in 1895-6. There were also 3,400 incandescents, and on the basis of the total output in kilowatt hours, these made a total equivalent of 1,235-2,000 candle power arcs. The operating expenses were $73,851.98. There was no debt, and depreciation, lost taxes and insurance on the total value of the plant ($348,921.39) at five per cent. were $17,024.72, making the total cost per full arc equivalent $73.53.

96 Mines for Havana.

A special dispatch from London, of April 13, says: Mr. J. P. Gibbins, who claims to have handled the submarine mines which were intended for use in Havana Harbor, and whose statements have been denied by the Spanish Ambassador here, says that Spain is denying some things that he never said. He reasserts that about ninety-six mines and fourteen tons of guncotton were furnished the Spanish Government for use at Havana by Latimer, Clark & Co., of London.

He, as superintendent of the submarine department of the firm, supervised the shipping of the material. Mr. Gibbins again affirms that he is able to prove absolutely that the Maine was deliberately and wilfully blown up. He says he believes he could fix the act on two men, and even one.

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Prices for Niagara Power in Buffalo.

THE utilization of electrical current developed at Niagara by industries attracted to the spot has already become an old story. Such utilization is steadily unfolding its successive developments, and the rate of advance will probably accelerate as the uses multiply. The future of Niagara Falls as an industrial centre seems to us assured beyond any peradventure, but that has only been one-half of the problem. The questions that Mr. L. B. Stillwell and his financial and engineering associates have had to determine lately have dealt with the larger problem of the profitable transmission and use of the current generated by Niagara, at points more or less remote, and at Buffalo, for a beginning. We know as a matter of fact, and it will be readily conceded, that the Cataract Power and Conduit Co. has found it a subject of no small difficulty to devise a system of charges applicable to its conditions and fair to all the other parties concerned. It will be remembered that tentatively, the power company began its Buffalo work by delivering current to the street railway system at the rate of $40 per horse power, scaling from that point downward as the quantity increased. But selling current en bloc, on the grand scale, is only one aspect of the Buffalo proposition, for, after all, what has been needed is the satisfaction of the legitimate hopes and claims of all the manufacturing industries that even now are pushing Buffalo to such a high place amongst the great cities of our land. The industries of the city are already varied far beyond any natural supposition, and if we are not mistaken, every Buffalonian worthy the beautiful city he lives in nourishes the desire to use the energy of distant Niagara for all the heating, cooling, lighting and driving, of his home, his factory, his office, or his store.

The executive committee of the Cataract Power and Conduit Co. has just adopted formally its system of rates, which we quote below. Experience alone, and perhaps not that of a mere year or two, can demonstrate whether the figures of the forecast are right, but knowing as we do personally the officials and experts who have been working on the many problems involved, we venture to express our belief that time will pretty exactly justify them. Not only have local conditions been considered, but those of other communities; and the rights of both the large and the small consumer of current have been weighed and adjusted. The rates are for three-phase alternating current delivered on the premises of the user at a potential of 2,200 volts. Under the contract existing between the Cataract Power and Conduit Co. and the Buffalo General Electric Co., users of power requiring not more than 75 e. h. p. shall be kept at their disposal, will be supplied by the latter concern, except in cases where it may be more feasible to reach them by the circuits of the Conduit Co. It may be inferred, as natural, in such a development, that for the present the practical application of the rates will be limited to the larger users of power; but it is understood that the Buffalo General Electric Co. contemplates an early revision of its schedule of charges, which will, in turn, secure to the users of smaller quantities of current, a fair share in the undeniable advantages of Niagara power.

Coming now to the rates themselves, we quote them below. The monthly charge for power will depend upon the actual amount used, as determined by standard meters installed by the Conduit Co. upon the premises of the consumer. These meters record the number of electrical units which are actually taken by the consumer. The standard electrical unit of power is the kilowatt hour, equivalent to about 1⅓ h. p. hours. The charge for power will be determined by the record of the meter and by calculation from the following schedule:

For use not exceeding 1,000 units, the rate shall be two cents per unit.

For use exceeding 1,000 units, but not exceeding 2,000 units, the rate shall be: For 1,000 units two cents per unit, and for the excess one and five-tenths cents per unit.

For use exceeding 2,000 units, but not exceeding 3,000 units, the rate shall be: For 2,000 units one and five-tenths cents per unit, and for the excess one and two-tenths cents per unit.

For use exceeding 3,000 units, but not exceeding 5,000 units, the rate shall be: For 3,000 units one and two-tenths per unit, and for the excess one cent per unit.

For use exceeding 5,000 units, but not exceeding 10,000 units, the rate shall be: For 5,000 units one cent per unit, and for the excess eight-tenths of a cent per unit.

For use exceeding 10,000 units, but not exceeding 20,000 units, the rate shall be: For 10,000 units eight-tenths of a cent per unit, and for the excess seventy-five hundredths of a cent per unit.

For use exceeding 20,000 units, but not exceeding 40,000 units, the rate shall be: For 20,000 units seventy-five hundredths of a cent per unit, and for the excess seven-tenths of a cent per unit.

For use exceeding 40,000 units, but not exceeding 80,000 units, the rate shall be: For 40,000 units seven-tenths of a cent per unit, and for the excess sixty-six hundredths of a cent per unit.

For use exceeding 80,000 units, the rate shall be: For 80,000 units, sixty-six hundredths of a cent per unit, and for the excess sixty-four hundredths of a cent per unit.

In addition to these charges for power, there will be a charge for "service" of about 75 cents per horse power per month. The current will be delivered at the start from three sub-stations, others following as the business grows. The company points out that a charge of $40 per horse power per annum may be a fair charge in the case of a user who requires a block of 300 horse power, and uses it twenty-four hours per day, but it is obvious that such a charge would be excessive if applied to the case of a grain elevator requiring that 300 horse power be kept continually at its disposal, but using that amount of power intermittently. It is evident, also, that the Cataract Power and Conduit Co. can afford to keep 300 horse power at the disposal of the elevator for a less sum than it is compelled to charge the customer who uses this full amount continuously during each twenty-four hours. The next step will be, of course, the installation of plants taking this power, and then we shall all be deeply interested in seeing how the results compare with those obtaining under the old regime of current generated on the spot, from coal and natural gas.

Clarke's Lecture on Wireless Telegraphy.

SINCE the epoch-making discovery of Prof. Röntgen a little over two years ago, which created such a stir in the scientific world and has conferred such incalculable benefits on mankind, no subject has engrossed the attention of the public to such a degree as the invention of wireless telegraphy and the manufacture of liquid air. These subjects have fairly monopolized the scientific press and have found large and interested audiences to witness the novel experiments, which naturally awakened in the inquiring mind an interest in the principles underlying their operation and in the final, practical applications to which they may lead. And, while there may be many silent workers on both problems, it is a curious fact, that in this country but two men have given out freely the results of their labors in these directions to the public, namely Messrs. Tripler and Clarke. A lecture was delivered by Mr. Clarke before the New York Electrical Society, and some of his results were published in our columns last week; and the very an-

imated discussion which it elicited cannot help but lead to very beneficial results. The discussion which was participated in by Dr. Pupin and Messrs. Mailloux, Dunn and Clarke dealt principally with the following points, which appeared from the discussion to be far from being settled or agreed upon: (1) The use of plates instead of wings, the essential feature being the length of the plates, and not their cross section, and the necessity of having them placed parallel to each other. (2) What takes place inside of the tube of the coherer, whether there is actual motion of the particles or a fusing action due to small sparks, or the elimination and re-establishment of a film of air between the particles. (3) The method of winding the high resistance relay coils without inducing self-induction in them. This is done by winding them in several coils and connecting in multiple. (4) The working of the transmitting device when the entire set of apparatus is enclosed in an iron box. (5) The practical application of the invention. Such uses as communication between ships and the shore, and telephoning without wires were discussed. The accurate tuning of the apparatus to prevent interference of signals was suggested, but no practical method for doing this has as yet been proposed. (6) The number and size of the balls on the transmitter and the distance between them was then taken up, and experiments seemed to show that the size of the balls has to be increased the greater the distance between the receiver and transmitter. Dr. Pupin expressed the belief that in the case of grounded circuits, it is not so much the action of the waves transmitted through the air that affects the coherer as it is the ground current running between the two plates. These plates are actually the two plates of a condenser which is being charged by the induction coil and the charging current causes the resistance of the coherer to diminish. Finally, Dr. Pupin believed that Mr. Marconi's apparatus does not represent the solution of the most important problem in connection with long distance signalling by means of electrical waves. He pointed out the necessity of using waves having very short periods and a small decrement. They should have very short wave lengths, so as to enable us to construct reflectors of reasonable size which could focus them, and they should have a small decrement, so as to be capable of producing powerful resonating effects, for without that selective signalling becomes impossible. So far as he knew, nobody has been able yet to produce electrical waves of excessively short period, and at the same time possessing small decrement, because to produce these rapid oscillations it is necessary to connect small conductors to the terminals of the induction coil, and in such cases the radiation of the electric waves is so enormous that the waves die out very rapidly, so that after the first half wave there is hardly anything left. This was the trouble for instance with the waves produced by Prof. Lodge and others. It was on that account that successful experiments on the reflection, and the interference of electrical waves became almost an impossibility. In a recent discussion given by Prof. Lodge and published in the "London Electrician" this difficulty, said Dr. Pupin, has been emphasized more or less forcibly. Now, as Mr. Marconi offers no suggestion in the line of solving this problem, and without the solution of this problem, selective signalling by means of electrical waves will be made an impossibility, Dr. Pupin thought that the commercial utility of the system will remain more or less small.

The Dangers of Excessive Conservatism.

IN a recent issue of an English contemporary we note in an editorial comment on the subject of American competition in Europe the remark that "Our (English) great fault, as a nation, is excess of conservatism." Seldom have truer words been spoken, but they are not true of England alone nor are they limited in their meaning and pertinent application. We find, for example, this same conservatism among mechanics in the shops who either oppose new methods or try to keep to themselves some antiquated trade secret that might benefit others. There are also individual companies whose excessive conservatism too often means the creation of suspicion on the part of the public on whose patronage they are dependent. This lack of faith is frequently unfounded and can only be eliminated by the adoption of a more liberal policy on the part of the management. It certainly cannot be their desire to hide from the purchaser the good features of their apparatus. The patent office grants them due protection on any new device or process, and only by an interchange of ideas or their publication can progress be made. Fortunately, America, one of whose proud possessions has always been its conservatism, has never carried this trade reserve to excess. The literature issued by American electrical manufacturers is becoming an important educational factor, besides having its purpose of advertising their goods. But our companies have long gone beyond this stage of imparting by catalogues a knowledge of their machines and methods. Instances of even more laudable methods are the very able and comprehensive series of articles in our late issues by Mr. Gano S. Dunn, who describes the design and important details and applications of the apparatus manufactured by the company of which he is chief engineer; and the article by Mr. Harry H. Cutler on "Motor Regulation and Control" concluded in this number. Articles such as these, written by men who have themselves designed and superintended the construction of standard apparatus are of the greatest value to the engineer and student.

Inventors, we might add, are a last class whose conservatism or secretiveness hinders them from realizing their ideals or reaching the goal. The art makes the quickest advance that has not one inventor working at it but fifty. In fact, it might almost be said that no new art is possible until its underlying ideas have become the common property of several fertile minds. These inventors toiling in a common field, deriving their common inspiration from one source, may regard each other askance and even speak of each other harshly, but in reality they are stimulating each other, helping each other along and perpetuating their art on solid bases. Conservatism is isolation. No art dies that has more than one practitioner. No invention succeeds until it has ceased to be the private ownership of one man.

EDUCATIONAL

Lectures at Purdue University.

The students of the Electrical Engineering Department of Purdue University, Lafayette, Ind., are to be especially favored this spring in the matter of visiting electricians who will address them along professional lines. Prominent among the list of the non-resident lecturers at the university are the names of Mr. Samuel Insull and Mr. Albion E. Lang, distinguished gentlemen who have already done much to advance the electrical interests of the country, and who stand at present among the most advanced thinkers and workers of America.

Mr. Lang, who is president of the Toledo Traction Co., and of the American Street Railway Association, will deliver an address at the university on the subject of "Electric Power Companies and Their Relation to Municipalities," on the 26th of this month.

Mr. Insull is at the head of the Chicago Edison Company, and is president of the National Electric Light Association. He will visit the university on May 17 and will lecture on the subject of "The Development of the Central Station."

Columbia University, N. Y.

The Electricity, Physics and Engineering Departments had their turn on Saturday last at the series of "University Teas," and it is said to have been the best of the lot, every condition favoring, the sunny spring weather bringing out crowds of society folk and showing off the new buildings and grounds to the utmost advantage. In the Physics Building, Prof. Hallock was to the front with a corps of ladies, and in the Engineering Building, Prof. Hutton was the most cordial of hosts. As for Electricity, it suffices to say that the hospitalities were extended by Dr. Pupin, Prof. Crocker, and Assistant Prof. Sever, who spared no pains to show things, especially to the ladies, who hung spellbound on their esoteric utterances. The gathering of well-known physicists, mechanical engineers and electrical engineers was wonderfully large and representative.

MR. HERBERT S. WYNKOOP has been appointed by Commissioner Kearny an inspector of gas and electricity at a salary of $2,000 per year.

Considerations Governing the Design of the Crocker-Wheeler Slow Speed Motors.—IV.

(Concluded.)

BY GANO S. DUNN, CHIEF ENGINEER.

It was a mooted question when motors of this type were first employed, whether they had any advantages other than compactness and convenience to set off against their greater cost and lower efficiency. Experience has shown that, for the equipment of new machinery where the attaching lugs, frames, etc., can be made at the place of manufacture, the first cost of

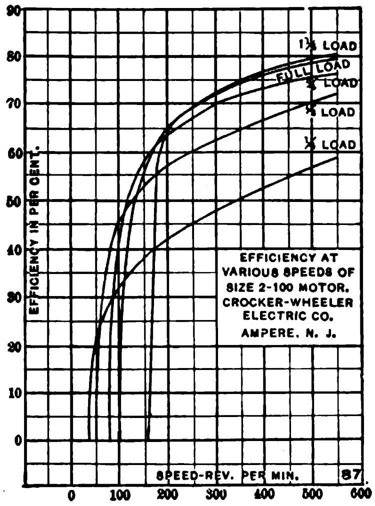


FIG. 6.—EFFICIENCY AT VARIOUS SPEEDS OF SIZE 2-100 C. W. MOTOR.

a direct motor in view of the omission of tight and loose pulleys and belt shifting devices, is not much different from that of a high-speed combination, erected in place, involving the cost of its gears and pinions to reduce the speed; but in the case of attachment to presses already built the advantage in cost,

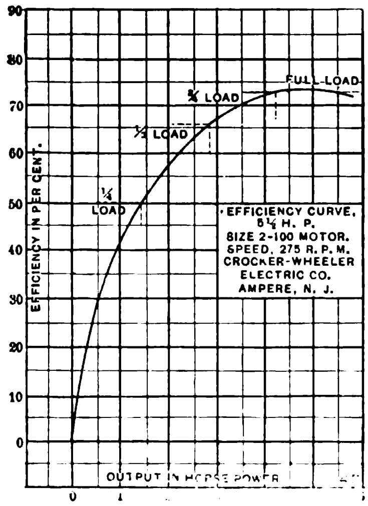


FIG. 14.—EFFICIENCY SIZE 2-100.

although not great, is with the latter. Similarly, as regards efficiency, a rule cannot be laid down, since the efficiency of the direct motors depends considerably on their speed. At the speeds at which printing presses usually run, from 100 to 250 per minute, the efficiency is about equal; below these speeds it favors the high-speed geared-down motor; above them, the direct motor.

To show how the efficiency of direct motors is affected by speed, we repeat Fig. 6, where, with efficiencies as ordinates and speeds as abscissæ, are plotted five curves giving the efficiency of a size 2-100 motor for normal speeds from 0 to 500 r. p. m. at the five points of ¼, ½, ¾, full, and 1¼ load respectively. It will be observed that the values drop very rapidly as the lower speeds are reached.

While the efficiencies are much lower than those of standard

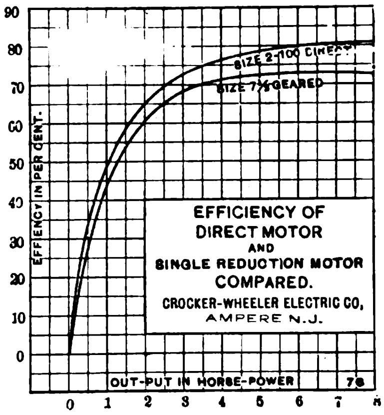


FIG. 15.—COMPARISON OF EFFICIENCIES OF DIRECT MOTOR AND SINGLE REDUCTION MOTOR.

motors, it is not because the machines are less carefully or liberally built, but because in proportion to their outputs, which are small in consequence of their low speeds, their losses form a large percentage. The efficiency of the 5½ h. p. motor is shown in the accompanying diagram, Fig. 14.

Fig. 15 shows the efficiency, after the speed-reducing mechanism has been included, of a high-speed motor geared down, and compares it with that of a size 2-100 running at the speed of the countershaft.

The various tools and machines to the driving of which these slow speed motors are applicable, are evidently very large. We can illustrate only a single example, namely, the printing press. An installation of this kind is shown in Fig. 16, which shows a ½-100 motor driving a quarto-Thomson press, and a 2-100 driving a No. 0 Whitlock press.

While designed principally for use as motors, these slow machines make excellent dynamos for direct connection to small gas and steam engines. These usually run at speeds varying

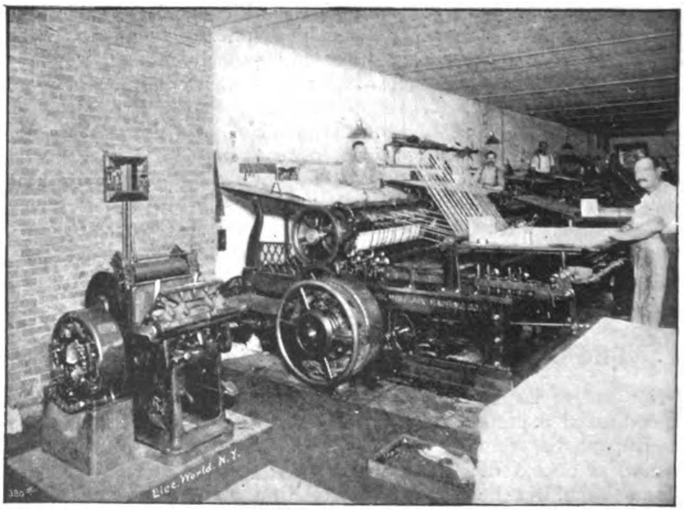


FIG. 16.—SIZE ½-100 on QUARTO-THOMSON OR UNIVERSAL PRESS, AND SIZE 2-100 ON No. 0 WHITLOCK PRESS.

from 300 r. p. m. to 500 r. p. m., sufficiently high to make possible an armature winding, whose resistance will come within the limits prescribed by good regulation for dynamos. For their size these dynamos are very efficient, their efficiency being practically the same as for motors of the same speed.

On account of the very large diameter and short length of armature which results from having more poles than dynamos of such small capacity usually have, they may frequently be con-

nected to engines without the use of a third or outboard bearing, which adds to the fine appearance of a combination and makes an important saving in floor space occupied, a valuable consideration in many cases—marine service, for example.

Fig. 17 shows a size 1-100 directly connected to a Sturtevant

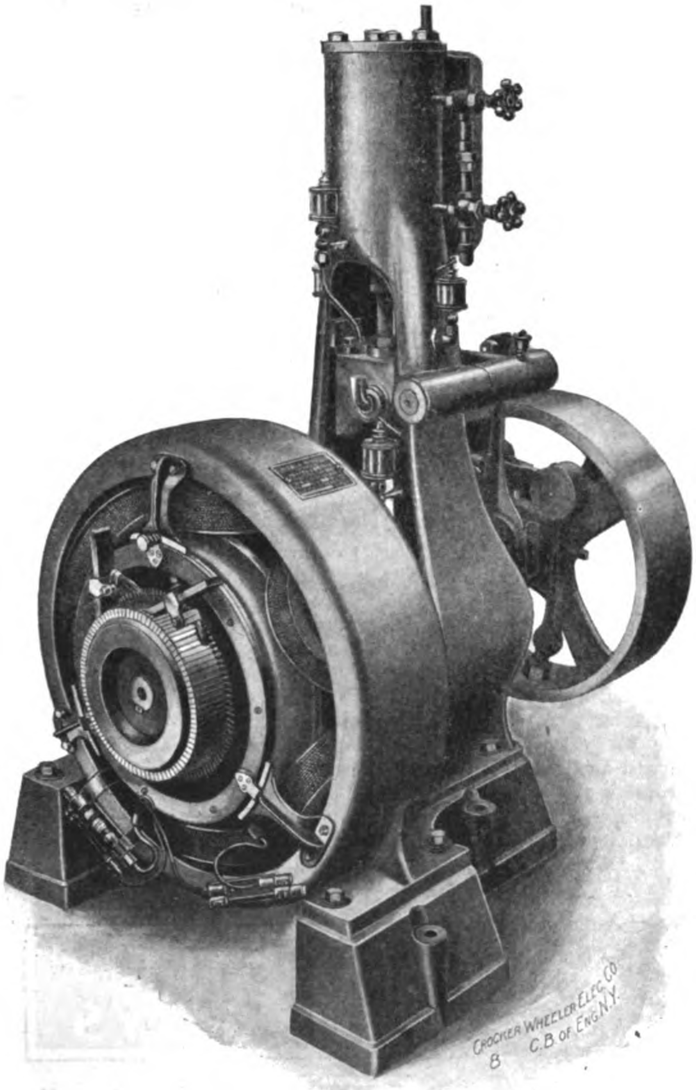


FIG. 17.—SIZE 1-100 DYNAMO DIRECT CONNECTED TO 4 x 4 STURTEVANT ENGINE.

4 x 4 engine at 500 r. p. m., giving an output of 3 kilowatts at 80 volts, for U. S. Torpedo Boat No. 8. The efficiency of this dynamo is extremely high for a small machine, being 80 per cent.

The Regulation and Protection of the Electric Motor.[1]—II.

(Concluded.)

BY HARRY H. CUTLER.

WHEN an elevator is coming down with a heavy load the motor has no work to do and consequently has a tendency to run away, being driven by the weight of the elevator. If the motor is plain shunt wound and its field kept at constant strength, the load on the elevator will tend to drive the motor so much above its normal speed that it becomes a generator, and returns current to the line. The speed of the motor will then increase until a potential is reached sufficiently above that of the lines to consume the power derived from the effective weight of the elevator. The motor will continue to revolve at this speed, which in case of the plain shunt wound motor would not be a dangerous speed. But plain shunt wound motors are now seldom used for elevators; almost all builders of elevators use compound wound motors, or at least shunt motors whose field is weakened after starting.

[1]Read before the Chicago Electrical Association, April 1, 1898.

Motors which bring an elevator to full speed by weakening the field would run much faster when driven by a heavy load on the elevator, and it becomes necessary for the attendant to check the speed by moving the lever back and thus strengthening the field. Should the attendant move the lever so far back that external resistance is inserted into the armature circuit, the speed of the elevator would be increased instead of decreased, as at first might be supposed, and a dangerous speed would result. This curious condition of affairs is due to the fact that with external resistance in the circuit with the armature when the motor is running as a generator, it will have to run enough faster to produce sufficient potential at the brushes to overcome the external resistance and deliver to the line the increased potential necessary to check the speed of the motor.

The application of the electric motor to the printing press is another problem full of interesting points, which time will not permit of taking up, and we will pass on to the second part of the subject.

THE PROTECTION OF A MOTOR.

Motors burn out when overloaded, because they get hot. They frequently burn out also because currents of high potential are allowed to occur which puncture their insulation. Excessive currents scar the commutators and foreign materials produce circuits which lead to damage.

To properly protect a motor from damage by the electric current, these four effects must certainly be guarded against.

Motors can only become dangerously hot by abnormal currents being allowed to flow for an appreciable length of time. A current of double or treble that of the continuous safe carrying capacity of the motor will not do the slightest harm, unless allowed to flow long enough to overheat the motor. When such abnormal currents last only a few seconds it is neither necessary nor desirable for the protecting device to operate, and a properly designed protector should not operate unless the temporary abnormal currents exceed this amount, or last long enough to overheat the motor. Since it is the heating effect of the current which causes an overloaded motor to burn out, the most natural protection would be a device that operates through the influence of this same heating effect of the current. The well known fuse was therefore recommended for this work and the electrical trade accepted it without question. As motors came into more general use it began slowly to dawn upon the electrical profession that they were being misled in their implicit faith in the fusible cut-outs offered by the trade. Too many motors supposed to be protected by fuses burn out, and experiments show that the ordinary commercial fuse will blow at almost any amount of current or not at all, just as it happens to feel at the time.

The manufacturers then attempted to more thoroughly standardize their fuses, and even made a faint attempt to standardize the cut-outs for holding them.

College professors took up the subject and made careful tests and wrote able articles about standardizing fuses. The conclusion which came was that the chief trouble lay in the fact that the fuses in common were so short that the terminals and blocks to which they were fastened caused their blowing point to vary, by conducting off heat which would otherwise have caused the fuse to blow. This they said could be entirely overcome by using fuses 6 or 8 inches long, and then we would have reliable fuses. Not enough significance appears to have been given to the cooling effect of the ever varying drafts of air to which the ordinary commercial fuse is exposed, and therefore to expect any exposed fuse, no matter how long, to blow at a certain predetermined amount of current, appears to the writer to be little short of an absurdity. People naturally become disgusted and look around for something better with which to protect their motors. Into this breach the magnetic circuit breaker bobbed up serenely with its claim for perfection.

The magnetic circuit breaker recognizes nothing but amperes, and takes no account of whether the motor is hot or cold. Now, amperes do not of themselves burn out our motors, it is the heating effect of these amperes, caused entirely by the length of time which they are allowed to flow. Volts on the contrary care nothing about time, so to speak; when the voltage gets high enough the current jumps, and the damage is done instantly, not through ordinary heat, but by the irresistible heat of the electric arc, which volatilizes the wires themselves. It should be noticed, however, that the excessive abnormal currents cause instant damage to the commutator of a motor, if not

to the armature itself, and should be cut down as quickly as possible. This latter office, the ordinary commercial circuit breaker will generally perform satisfactorily. It becomes a nuisance, however, by opening the circuit and interrupting the service at every little temporary abnormal fluctuation of current, which current would not do the slightest harm and calls for no protection. What is needed then for properly protecting the motor is, first, a device that will not allow extremely abnormal currents to flow into the motor at all; second, one that will allow slightly abnormal currents to flow through the motor, until the motor begins to approach a dangerous temperature; and third, the device should check an excessive flow of current so that no undue strain will be put upon the insulation of the motor. No such ideal protection exists to-day, to my knowledge.

The first requirement would be very difficult to meet, and the best that has been done so far is to stop the flow of an excessive current through the motor as quickly as possible. The other two requirements are more easily complied with. To protect a motor from heat it is evident that the heating effect of the current should be utilized in the protcetive device. This is accomplished in at least two devices now on the market, namely, the enclosed fuse and a peculiar make of circuit breaker, designed by the writer. Both of these devices are shown by samples on the table. The enclosed fuse shown is of the D. & W. make, and the fibre case has been removed in order to show its construction more clearly. The distinguishing feature of this fuse is the enclosed air chamber, around the fuse proper, consisting of a gelatine capsule, similar to those used by apothecaries for filling with quinine and other medicines.

The fuse proper is very short and is contained entirely within the capsule. Copper wire leads are connected to the fuse and lead out to the terminal caps, through closely packed sand or plaster of paris. The capsule provides a definite amount of air within which the explosion takes place, thus greatly increasing the accuracy of blowing at predetermined currents. The force of the explosion is taken up by the layers of sand on each end and as there is no air and but little metal to feed the arc, it immediately goes out. These fuses are surprisingly accurate, and being absolutely sparkless, would certainly appear to be an ideal protection both for the motor and as against fire. They are ahead of the times, however, and the vast majority of those who operate motors still cling to the old bare fuse, working in the open air, for the protection of their motors.

Circuit breakers are being introduced very rapidly, however, as a protection for motors, and I have one here which is constructed on a somewhat different principle from anything on the market.

The action of this circuit breaker depends upon the combined magnetic and heating effect of the current. Its mechanical construction is very similar to the usual type, the chief difference being that the magnet or solenoid used to release the trip or catch, carries only a portion of the current passing through the breaker. The rest of the current is shunted around the active coil of the circuit breaker, just as Edward Weston does in his well-known station ammeters. The shunt used in this circuit breaker, however, is composed of material whose resistance increases very rapidly as it becomes heated. The action of this circuit breaker is very simple. On starting up a motor under load, both motor and circuit breaker are cold, the resistance therefore of the shunt on the circuit breaker is at its lowest point and it carries then the largest part of the current flowing through the breaker. As this current continues to flow the shunt heats up, its resistance increases, and more current passes through the magnet or active coil, which will finally act, should the abnormal current last long enough to become dangerous. It is also evident that an extremely abnormal current or a short circuit would not wait for the heating effect of the current, but would cause the breaker to open instantly.

In practice these breakers are generally so proportioned as to allow a current of 50 per cent. greater to flow for a second, than would finally open the circuit if allowed to flow for a minute or two. Any current over 60 per cent. greater than the continuous current which would finally open the circuit breaker, will do so instantly.

A modification of the circuit breaker is the so-called overload attachment to motor starting boxes provided with the magnetic release. One of these boxes can be seen on the table. They are frequently spoken of as an under and over load motor starter. All the various makes of this type of motor starter use an electro-magnet for retaining a switch or rheostat lever in closed circuit position. This retaining magnet is wound so as to connect in series with the shunt field, in series with the armature, across the lines or in series with external resistance across the lines. The overload magnet is invariably connected in series with the armature and carries usually the entire current supplied by the motor. When the current becomes excessive it attracts its armature and demagnetizes the retaining magnet by short circuiting or opening the circuit of the windings of the retaining magnet. There are also several other ways of demagnetizing the retaining magnet.

A surprising degree of accuracy and reliability can be obtained in this way of protecting a motor from overloads. The system has, however, one chronic fault, which appears to have been entirely overlooked, and that is, that no device constructed on the above principle can possibly act quickly enough to protect a motor against extremely abnormal currents, short circuits or lightning, notwithstanding all circulars and advertisements to the contrary. It takes time to demagnetize a magnet, no matter whether it is short circuited or open circuited, and this time is fatal on short circuits, and the motor will not be protected. We must then choose some combination of the various methods just described of protecting a motor. We have here on the table such a combination, which would appear to afford adequate protection for the least money. This device utilizes enclosed non-arcing fuses, the magnetic release, overload magnet, and double pole knife switch. The magnetic release affords ample protection from liability to damage from interrupted current. The overload magnet takes care of all ordinary overloads, and also performs the office of an ammeter which will indicate the approximate load on the motor at any time. The fuses are selected so as to blow on 100 per cent. overloads up to short circuits. The overload magnet can also be provided with the time limit device, described above in connection with circuit breakers. This method of protecting a motor is laid before you for your consideration, and I desire to place myself on record as believing that with such a device on the market for protecting a stationary motor, there are very few places or conditions where the ordinary magnetic circuit breaker will afford equal protection and satisfaction, or be provided at as small a first cost.

New Designs in Static Machines—The Jewell.

THE use of static machines for X-ray work has given a decided impetus to the improvement in design and manufacture of this hitherto rather neglected type of instrument. Various concerns are putting out static machines regularly of a size and perfection that could heretofore be found only in private laboratories for which they had been made specially to order. A representative of The Electrical Engineer was recently much interested upon being shown a new static machine designed by W. S. Jewell, electrician of the McIntosh Battery and Optical Company at Chicago. The results from this machine are quite remarkable considering its small size. It is a modification of the Toepler-Holtz machine in principle, has four 25-inch plates and is self exciting, and a nine-inch spark has been obtained from it. The most striking thing about the machine, however, is the ease with which it runs, due to the fact that ball bearings are used. A 12-inch fan motor of Western Electric make is sufficient to drive it, and in fact after the machine is up to speed it will continue to run for a long time by momentum, quite contrary to the habits of machines with plain bearings. Another point demonstrating the efficiency of the ball bearing was noted by the writer, viz., that when the machine was allowed to slow down and stop of its own accord with a charge on, the attraction of a charge on the plates would make the plates revolve backwards a part of a revolution after the first stop, the action being of course the same as a static voltmeter. In size this little machine was only about half that of one of corresponding generating capacity standing near it, of the old design.

MECHANICAL

Instrument for Delineating Topographical Peculiarities and Measuring and Recording Distances.

THE demand for a speedy method of making preliminary surveys without the usual array of engineers and instruments, seems to have been met by a device, recently invented by John Riddell, of the General Electric Company, Schenectady, N. Y., and entitled "An Instrument for Delineating Topographical Peculiarities and Measuring and Recording Distances."

It is small and compact and may be mounted on a bicycle or upon any wheeled vehicle drawn by horses or pushed by hand or foot. It is shown in Fig. 1 mounted on the horizontal upper bar of a bicycle and consists, briefly, of a vertical revolving cylinder carrying the record, and a marker moved upwards and downwards by the inclination upwards or downwards of the upper bicycle bar.

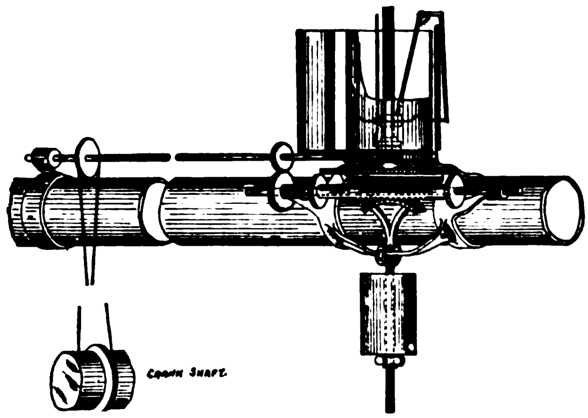


FIG. 1.—RIDDELL RECORDING INSTRUMENT MOUNTED ON A BICYCLE.

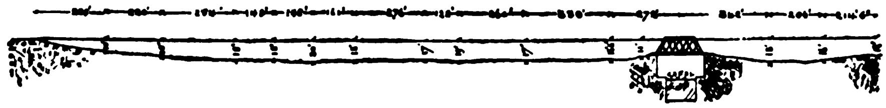
The metal cylinder carrying the paper for the record is provided at the lower end with a worm wheel engaging with a worm on a shaft running toward the rear of the bicycle and driven by a lace belt from a pulley on the crank shaft. Movement of the bicycle produces, therefore, revolution of the record cylinder, which, as it revolves, unwinds the paper for the record from a small drum.

The marker is mounted on a nut on a threaded vertical rod, movement of which raises or depresses the nut and the marking point. The lower end of the rod is fastened to a horizontal disc free to move clockwise or the reverse. Beneath the disc, and just clearing it on each side, are two smaller discs, at each end of a toothed sleeve, and revolving vertically. Through the sleeve passes the disc shaft provided with a gear wheel meshing into a small gear on the main shaft driven from the crank axle.

Suspended beneath the bar of the bicycle, and, consequently, beneath the entire machine, is a pendulum having at its upper end a toothed quadrant, meshing into the teeth of the sleeve on the shaft carrying the vertical discs. As the small discs revolve in the same direction, one in contact with the large horizontal disc revolves it clockwise and causes the marker to ascend, the other counterclockwise depressing the marker. The nearer the centre of the large disc the small disc comes, the faster the former moves and the sharper the angle described by the marker.

It will be seen that the pendulum hangs vertically whatever be the angle of inclination of the bicycle. If the machine is ascending the horizontal bar assumes an obtuse angular position to the pendulum, the rear vertical disc is brought beneath the horizontal disc and the marker moves upward; if a declivity is descended, the angle of the bar and the pendulum becomes acute, the forward disc comes into play and the marker moves downward. On the level both vertical discs are out of contact with the horizontal disc and the marker records a plain horizontal straight line.

A part of a record is shown in Fig. 2. The number of feet above the level are shown by the horizontal line, the distance traveled by the length of the record. It is part of a record made on a wheel ridden from the gates of the General Electric Company's factory to the main street of Schenectady.



PORTION OF RECORD MADE BY RIDDELL RECORDING INSTRUMENT.

The value of a device of this character will readily be appreciated by military, civil and railroad engineers. At present if a piece of road requires survey, or the lay of the land in a certain direction is to be ascertained, a system of survey is necessary involving considerable time and labor. Recent mention was made of the rapidly accomplished survey of 49.22 miles in 19 hours by means of a bicycle and compass. The mapping of the line surveyed occupied several hours additional labor. With a device of the character of that mentioned the completed topographical profile could have been ascertained in the time taken to propel the wheel over the length of the road surveyed.

It could also be widely used by bicyclists and drivers of horses or livery stable keepers and in the development of road maps, which, at present, give distances and rarely gradients.

MISCELLANEOUS

The High Tension Electric Storage Battery.

STORAGE batteries have in the past been constructed in a great variety of shapes embodying numerous ideas intending to increase their efficiency or their life. But what may fairly be claimed to be the most remarkable storage battery, which has yet come under our notice, is that now employed in furnishing current for lighting the town of Souderton, Pa., a place of some 3,000 inhabitants situated about 30 miles from Philadelphia.

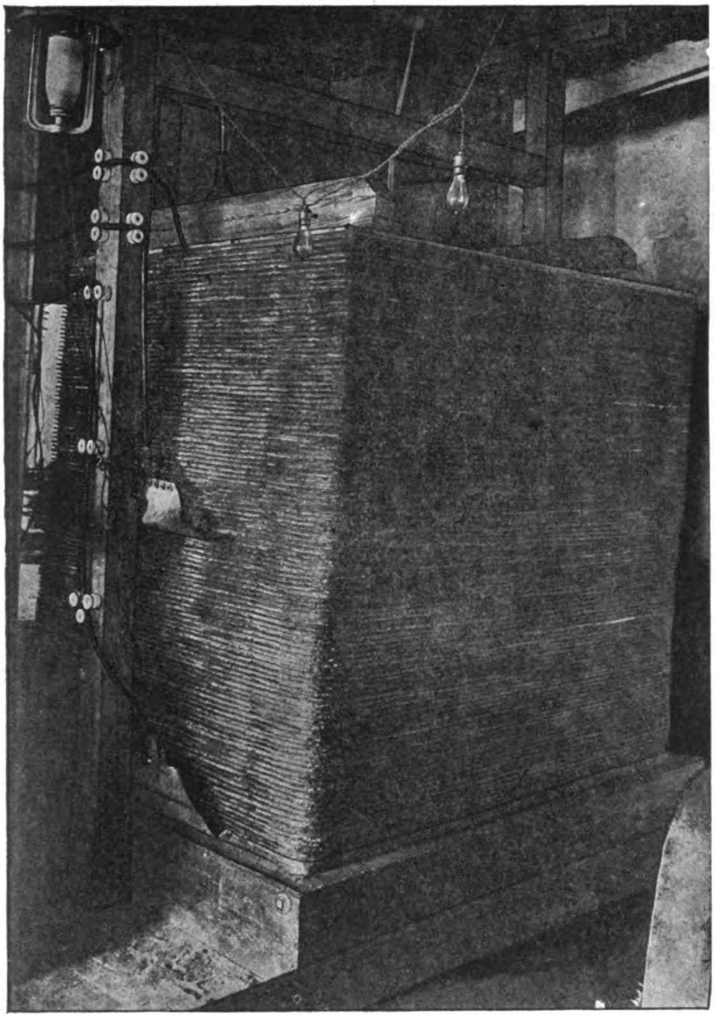
Imagine a structure, as illustrated in the accompanying engraving, Fig. 1, consisting of 110 lead plates piled one above the other, each plate 6 feet wide by 7 feet long, the total height of the battery being 7 feet, and weighing no less than 16 tons; and what is particularly striking, the whole being exposed without any enclosing tank whatever. Such is the structure which meets the gaze of the observer.

Before going into the details of the construction of the cell it may be well to recall that it is now several years ago that Prof. N. H. Edgerton, whose electric motor will be recalled by many electrical engineers, whose memories go back to the beginning of electric motor work, conceived the idea that a battery could be made which would furnish any desired potential and in a form practical for every class of work. Striving along this line, Prof. Edgerton's work finally crystallized into a type of battery, in which each plate formed as it were a couple by itself, one side acting as the positive and the other as the negative in a battery, and thus, at the very outset reducing the number of plates required one-half.

The next problem was to so group these plates that they could be maintained in position so as to permit of the introduction of the necessary electrolyte, and to keep it in place.

With this explanation of the principle involved, we may return to the large battery already referred to. Each plate of this cell, excepting the one at the bottom, is coated on its under side to the depth of one-eighth of an inch with litharge. This

forms the negative side of the plate. In the hollow on top of the plate is a layer of red lead also one-eighth of an inch in



• FIG. 1.—SINGLE CELL 220 VOLT HIGH TENSION STORAGE BATTERY, SOUDERTON, PA.

thickness, which is covered with a thin sheet of asbestos, and on this again is spread a layer of granulated oak charcoal, covered with a sheet of muslin. The plates thus prepared are piled one on top of the other, the result being that, as above stated, each plate constitutes in itself a positive and a negative, with a result that there is an e. m. f. of 2.2 volts between each two contiguous plates. The electrolyte, of sulphuric acid, is syphoned in between the plates and is absorbed and held in place by the granulated charcoal.

In the large battery illustrated, 110 plates of this kind are piled one on top of the other so that at the terminals there is a pressure of 220 volts. Actual measurements with a Weston voltmeter showed a difference of potential of 225 volts on open circuit, and its normal capacity is 3,000 ampere hours.

This large cell is located in the works of the High Tension Electric Storage Company at Souderton, Pa., and, as stated above, furnishes current for all the public and private lighting in that town, consisting of 24 arcs and 600 incandescents, the latter connected to three-wire circuits.

For the charging there are employed three dynamos, two of forty kilowatt capacity, respectively of the Eddy and C & C type. One of these machines is of 250 volts and the other 500. A third machine built by the Electro Dynamic Company is of 110 volts and is employed as an equalizer to feed such size of the 220 volt battery, which may require to be brought up in charge equal to the other side when the two sides are unequally drawn upon. This great cell is charged at a density of 250 amperes, but this can be raised to 2,000 for a short time without injury.

The advantages claimed for this type of a cell are that in the first place it is impossible for any of the active material to fall away from the plate, so that it constantly maintains its original capacity; while at the same time preventing short circuiting between the plates. It is also pointed out that the current passes through from one plate of the cell to the other with absolute uniformity of density, each square inch giving out and receiving an equal current at every point on the plate so that the action on the active material is absolutely uniform throughout. Then again the question of terminals is practically done away with as there are only three terminals in the whole battery of 220 volts, one at each end plate, and one in the middle.

While the battery just described represents the largest work of the company thus far undertaken, it is evident that there is practically no limit to the potential which can be obtained by cells constructed in this manner. As a matter of fact, we are informed that the company is now about to undertake, on an order, the construction of a battery to deliver 1,000 volts.

It will be evident, however, that besides central station work the battery is particularly adapted for private plants and for portable work. Thus, among the electric lighting plants equipped with the High Tension storage battery, is that in the Independent Building at Souderton, Pa., where twenty 16 candle power lamps are installed, operated from the storage battery. This battery is charged with a dynamo run by a 2 horse power Witte gasoline engine, which also furnishes power to run a large cylinder press and paper folder at the same time.

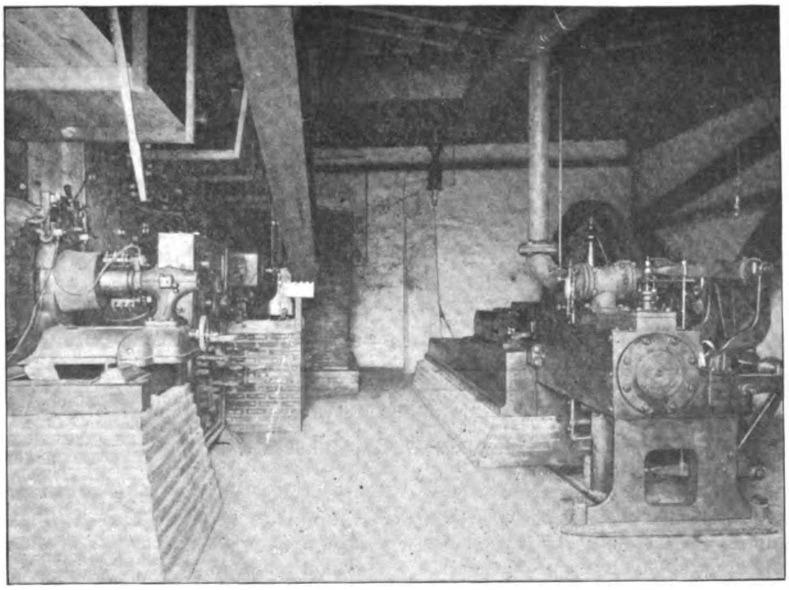


FIG. 2.—VIEW IN ENGINE ROOM, HIGH TENSION ELECTRIC STORAGE CO., SOUDERTON, PA.

It must be evident that the High Tension cell is peculiarly adapted to portable work. The company have recently placed on the market a carriage lighting battery and have also designed a large variety of types of batteries for special work such as for the use of physicians, batteries for lantern projection, and for general uses of all kinds. We may also add that a High Tension battery of the type described has been in actual operation lighting an apartment house in Philadelphia during the last two years.

The works of the company are situated at Souderton, Pa., and are thoroughly equipped for carrying on the company's work, and located directly opposite the tracks of the Reading Railroad so that its shipping facilities are of the best. A view of the engine room of the High Tension Electric Storage Company, of Souderton, Pa., is shown in Fig. 2. The offices of the High Tension Electric Storage Company are in the Heed Building, 1215 Filbert street, Philadelphia. Prof. N. H. Edgerton, inventor of the battery, is president of the company, and the following are the officers: Dr. Joseph H. Wilson, vice-president; A. M. Gissinger, secretary; J. K. Clenner, treasurer; J. B. Alderfer, general manager.

NEWS AND NOTES

Heavy Telephone Cable Laid Across the North River for the Use of the Government.

ONE of the strongest evidences of the great activity which now exists in the various departments of the Government are the large orders placed for electrical apparatus and the unlimited supply of submarine cables which have been ordered for immediate delivery. These cables will be used for various purposes such as the establishment of telegraphic and telephonic communication between the numerous coast defences and the wiring of mines and torpedoes which have been placed in several harbors or near fortifications. Cable factories have been running full force day and night for some time, and as soon as the cables are completed they are laid with the greatest dispatch. The extensive use which the Government is making of the telegraph and telephone lines has necessitated the companies owning these lines to lay additional cables and string more overhead wires in order to meet this sudden and urgent emergency. One of these companies has been the American Telegraph and Telephone Company, which only a few days ago accomplished the remarkable feat of stringing six overhead wires from Philadelphia to Washington in six days. The New York Telephone Company already have about fifty submarine cables joining the New York and Jersey shores, but in order to meet the increasing demand in its business and for the reasons given above, they have placed an order with W. R. Brixey for three additional submarine cables, one of which was successfully laid on April 15. The cable, which is one of the heaviest of that kind ever manufactured, is 4,850 feet long and weighs about 16 tons. It consists of 20 conductors of 3 strands each of No. 22 B. W. G. covered with ¼-inch Kerite insulation. These conductors are protected by 25 No. 4 B. W. G. steel armor wires and these are covered by a layer of jute and tar. The cable is about 2½ inches in diameter and its weight per mile is about ten times that of an ordinary ocean cable. The tug "Western Union, commanded by Captain G. T. Olmstead, left Pier 13, foot of Cortlandt street, New York, after the end of the cable had been made fast. The cable, which had been transported from the Brixey factory at Seymour, Conn., had been wound on a reel and placed on board of the tug at the Harlem depot of the N. Y., N. H. & H. R. R. To prevent the layers from sticking together, the cable had been covered with soapstone, and brass rings were fastened around it every 100 feet. One end of the cable had been passed through a "snatch block" fastened to the end of the boom, and as the tug slowly moved away from the dock the cable was paid out by revolving the drum on which it was wound, by means of a small engine. As soon, however, as the tug had moved out for some distance, the steam power was cut off and the cable was paid out at the rate of twelve miles an hour. Inside of six minutes the cable was laid and the remaining 600 feet were run beneath the Jersey City dock, known as Pier C, terminating in the new cable house of the New York and New Jersey Telephone Company. Here it was connected to the wires which had recently been run in the newly laid conduits, which will accommodate over two hundred wires. The laying of the cable was superintended by Mr. A. Kline, who has been connected with cable laying for over twenty-five years. Others who witnessed this interesting operation were Messrs. W. R. Brixey, Geo. F. Porter and G. C. Allen, Superintendent of Construction of the New York Telephone Company.

Preparations for War.

If the preparations going on elsewhere equal those in New York, electrical engineers are doing their share for the country. We have already referred to the splendid initiative of Captain Eugene Griffin, but he himself could not have wished more spirited and energetic seconding than has come from the New York Edison Co., of whose staff Mr. Arthur Williams has been specially active. We do not propose to go into details, any more than we did last week, but may simply say that the work done around the approaches to New York, by the volunteer electrical forces thus marshalled, promises the hottest kind of a time night or day, for any ship or fleet that noses up to our coast.

Rychnowski's Electric Fluid.

The following delightful item comes from London, dated April 15, where the scientists failed to intercept it: "A dispatch to the 'Daily News' from Vienna says that Sczcepanik, the inventor of the Fernseher, and his financial partner, Kleinberg, have gone to Lemberg to negotiate for the purchase of an invention of an electrician named Rychnowski, who claims to have discovered 'the electric fluid.' He calls it electroid. It is not identical with electricity. It is said that it produces light, causes Geissler tubes to show fluorescent rays, rotates objects in the air, produces whirlpools in water, kills bacteria, and performs other wonders. The correspondent rather unkindly adds that the invention has not as yet been scientifically examined."

Rules for Interior Wiring.

The Department of Public Buildings, Lighting and Supplies, of New York City, Henry S. Kearny, Commissioner, has just issued its new rules and regulations for interior wiring. They are admirable in every respect, and should do much to promote good work in the Greater New York, bringing it all up to the high standard set by Mr. Alex. Henderson, the Chief Inspector.

SOCIETY & CLUB NOTES

Fifth Annual Reception and Exhibition of the New York Academy of Sciences.

THE New York Academy of Sciences held its fifth annual reception and exhibit of recent progress in science in the American Museum of Natural History on April 13 and 14, 1898. On the evening of the 13th a reception was tendered to the members of the Academy and invited guests. During the evening of the 14th, members and their friends viewed the exhibits and in the evening there was a reception to the members of the Scientific Alliance, when a demonstrative lecture was delivered by Prof. Geo. E. Hale, on "The Function of Large Telescopes." This was preceded by an introduction by the president of the Academy, Prof. Henry F. Osborn, and by the president of the Museum, Morris K. Jesup, Esq. For a number of years the exhibits of the Academy have been noted for the great variety of scientific apparatus shown and the very interesting and popular demonstrations of scientific investigations. The exhibition this year was exceptionally instructive, and of the numerous exhibits the following deserve special mention: In the department of anatomy, in charge of Geo. S. Huntington and Jos. A. Blake, radiographs showing the topographical relations of the

trachea and bronchi to the thoracic walls. In the department of chemistry, in charge of Dr. Charles A. Doremus, experimental illustrations on liquid air and its properties were given by Mr. Charles E. Tripler, which were highly appreciated by a large number of interested visitors. Prof. Morris Loeb and Mr. J. H. Shipley exhibited a method of preparing pure tellurium and some of its compounds. In the department of electricity, in charge of Mr. Geo. F. Sever, the following apparatus was exhibited by Prof. M. I. Pupin: A thirty-inch spark induction coil, built by L. R. Lovejoy; electrical oscillators for selective signaling; an optical telephone; bridge for measuring phase retardation between current and electromotive force. Mr. J. G. Biddle exhibited some of his improved electrical apparatus, such as the Willyoung induction coil, and direct reading potentiometer; the Rowland electro dynamometer; and the Rosa curve tracer for alternating current curves. Mr. W. J. Clarke showed his apparatus for the transmission of signals at a distance without wires in actual operation, and Mr. G. C. Halk exhibited the following apparatus for Queen & Co.: The Queen Acme testing set; a complete twelve-inch X-ray outfit, with self-regulating tube; various styles of galvanometers and a self-focusing lamp, built by Messrs. Baker & Fox, which has many commendable features. Other interesting exhibits were shown in the departments of ethnology; experimental psychology; geology; mineralogy; philology, photography and physics, which was in charge of Prof. Wm. Hallock. In this department much novel and interesting electrical measuring apparatus was shown, as well as some photographs showing the penetrability, the path and the refraction of Röntgen rays.

President Insull to Attend.

Mr. Samuel Insull, president of the National Electric Light Association and of the Association of Edison Illuminating Companies, was in New York last week. He takes a very lively interest in the progress of the Exhibition, and has informed the management that he will take the utmost pleasure in coming on specially from Chicago, in behalf of those two representative bodies, to participate in the opening exercises on May 2. These exercises as now arranged promise to be of an unusually striking and interesting character.

The Coming Telegraph Tournament.

The telegraph tournament judges held a meeting at the Astor House on April 13, among those present being Fred Catlin, T. J. Smith, J. B. Taltavall, H. W. Pope, George H. Guy, A. E. Sink, E. A. Leslie, W. D. Weaver, P. T. Brady, P. B. Delany, S. F. Austin, T. R. Taltavall and William Maver, Jr.

The meeting was called to order by Mr. Catlin, who was elected chairman. J. B. Taltavall was elected secretary. After some discussion it was decided that the conditions to govern the judges in their decisions, as printed in the circular which has been widely circulated, sufficiently covered the ground.

An executive committee was then appointed to take care of all matters embraced in the duties of the judges.

The executive committee, consisting of Fred Catlin, A. E. Sink, T. J. Smith, P. B. Delany and J. B. Taltavall, held a meeting immediately after the judges adjourned. Mr. T. J. Smith was appointed a committee to arrange for suitable phonographic records, and Mr. P. B. Delany to provide apparatus for chemical or other records not phonographic.

The executive committee then adjourned, to meet on April 21.

Mr. A. E. Marr, of the Associated Press, an exceptionally good code operator, has been added to the list of judges.

The Smith-Premier Typewriter Company state that those living at a distance who desire to use their machine in the contests need not bring their typewriters with them to New York. Mr. W. H. Durphy, the New York manager of the company, is prepared to furnish all comers with typewriters.

Mr. Fred E. Burnell, of New York, proposes to enter one or two events in the tournament, more with the idea of demonstrating the fact that telegraphers' paralysis is a curable disease, and giving telegraphers a practical demonstration of his complete cure by electricity itself.

Friday evening, May 13, and Saturday afternoon and evening, May 14, are the dates on which the tournament will take place.

Offices of the Exhibition.

Mr. Marcus Nathan, the general manager of the Exhibition, has moved his offices from 15 Cortlandt street, to Madison Square Garden, where he can now be found directing and managing matters. Annexes of the Garden to be used for the Exhibition, have already passed into his control, and the huge main hall will be turned over to him at midnight on April 25. The following week will see some great work done in the transformation of Buffalo Bill's prairie and desert scenes into the dazzling spectacles of electricity's triumphs.

The Stieringer Fixture Litigation.

It appears by papers filed in the Supreme Court on April 16, 1898, that the suit brought by Luther Stieringer against Richard N. Dyer and George Maitland for an accounting has been settled. Under the judgment which Mr. Stieringer had obtained in the action, the patents had been transferred to Mr. George Flint Warren, Jr., as receiver, and he had assumed management of the business under the patents. It seems that Mr. Stieringer has secured recognition of his claims on this settlement to the extent of some $15,000 to date, and a continuing increased interest in the future income from these patents. The settlement also involves the withdrawal of an appeal which had been taken and was about to be argued.

Waiting and Wondering.

The general conditions of the country may be said to have followed with closely sympathetic rise and fall the changes in the aspect of our international quarrel. The uncertainty of it all is not doing much good to anybody. If there should be war, the expenditure of large sums of money would stimulate trade, even though artificially. If there is peace, industry will at once expand in normal channels. But the long doubt and anxiety tend to slacken energies in all lines.

During the past week 5,076 shares of Western Union were sold at about 85½, a net loss of ¼. General Electric, after sales of 5,045 shares, closed 1½ lower at 31¼. All local electrical stocks were dull. In Boston, American Bell Telephone closed the week at 250.

WILLIAMS ELECTRIC CO., of Cleveland, O., has been incorporated with a capital stock of $25,000 by J. A. Williams, W. G. Meade, F. J. A. Keller, B. J. Chamberlin, and G. Gebhard.

J. JONES & SON will move on May 1 from their present quarters to new ones. They will occupy the entire building No. 64 Cortlandt street, giving them four stories, a liberal allowance of space for the factory and ample room for the handling and selling departments. As a matter of fact, the firm will just about double their space for manufacturing, but this is needed to keep pace with the increase in the demand for their goods. Mr. E. A. Lowe, their manager, informs us that they have recently booked an order from the U. S. Government for shipment to one of the Southern ports of a general equipment of electrical apparatus. It will require four railroad cars to transport the material.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued April 12, 1898.

Alarms and Signals:—

ELECTRIC BLOCK SYSTEM. F. Burger, Ft. Wayne, Ind., 602,208. Filed Aug. 2, 1897. Employs a switch-operating magnet whereby when a car enters a section the corresponding magnet is energized to open the switch and break the circuit controlling the rear section; and when the trolley leaves the section and enters a succeeding section, the trolley operates the switch to restore it to its normal position.

Batteries, Secondary:—

SECONDARY BATTERY. F. W. Schneider, Triberg, Germany, 602,172. Filed June 10, 1897. Consists of an insulating and supporting frame especially adapted for horizontal—for instance, tubular or trough shaped—secondary batteries.

STORAGE BATTERY. G. A. Washburn, Cleveland, O., 602,176. Filed May 22, 1897. An electrode having on each side a series of groups of concentric ring shaped projections of uniform cross section, and equally spaced at all points to hold active material between them and standing out above the adjacent surface of the plate and a hole centrally through each group.

Batteries, Primary:—

GALVANIC BATTERY. W. Rowbotham, Birmingham, England, 602,362. Filed Dec. 16, 1896. A hermetically-sealed electric battery having a depolarizing liquid compartment and the liquid expansion chamber located in juxtaposition to one another, and tubular carbon elements communicating with the expansion chamber.

Conductors, Conduits and Insulators:—

PROCESS OF FABRICATING METALLOCERAMIC RESISTANCES. L. Parvillée, Paris, France, 602,227. Filed Nov. 13, 1897. Consists in mixing a metallic powder with extraneous bodies such as quartz, kaolin, clay or feldspar and with a flux, subjecting the whole to pressure and then firing the same.

Distribution:—

ELECTRIC TRANSFORMER. L. Gutmann, Pittsburg, Pa., 602,218. Filed Oct. 31, 1890. Comprises a core element consisting of a plate of magnetic material having two or more recesses causing extensions, and a strip adapted to interlock with the extensions.

Dynamos and Motors:

DYNAMO FOR ELECTRIC CAR LIGHTING SYSTEMS. E. J. Preston and A. B. Gill, London, England, 602,182. Filed Feb. 25, 1895. Comprises a dynamo connected by a pulley to the axle of the car, means whereby the dynamo is drawn away from the axle to give the belt the proper tightness up to a certain speed, and further means to draw the dynamo toward the axle when the speed exceeds the pre-determined limit.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. Weber, Paris, France, 602,380. Filed Sept. 11, 1897. Comprises a frame and electromagnet, a magnetic disc in the field of the magnet, a brake for the disc, an armature co-acting with the magnet and controlling the brake, the magnet serving to retard the revolution of the disc, and a carbon holder having connection with the disc.

ELECTRIC ARC LAMP. J. Mueller, Cleveland, Ohio, 602,404. Filed Aug. 27, 1897. Feed mechanism for open arc lamps.

Miscellaneous:—

ELECTRIC CORD ADJUSTING DEVICE. F. N. Lawton, Summit, N. J., 602,235. Filed April 5, 1897. Consists of a metal wire, having a smooth curved exterior surface, bent into a series of successive loops arranged in the same plane, and having a layer of insulating vitreous enamel thereon.

PROCESS OF AND APPARATUS FOR ELECTRODEPOSITING. E. L. Dessolle, Epinay Sur Seine, France, 602,212. Filed Aug. 25, 1897. Consists in first saturating the surface of the cathode, which is of metal capable of occluding hydrogen, with hydrogen, electrocoating the cathodes with metal, and then stripping the deposit from the cathode in order to prevent the adherence of the metallic deposit to be afterwards made.

SUSPENDING BATTERIES ON CARRIAGES. R. T. D. Brougham and W. C. Bersey, London, England, 602,302. Filed Dec. 13, 1897. Comprises a box, springs suspending the box from the carriage frame and a rod pivoted at one end to the frame and at the other end to the box.

MANUFACTURE OF REFLECTORS. S. O. Cowper-Coles, London, England, 602,306. Filed June 10, 1897. Consists in applying to a prepared mold, a coating of silver or other suitable metal, then depositing thereon electrically a backing of base metal, and then separating the reflector from the mold by heating the same in a water-bath.

SYSTEM OF ELECTRICAL PROPULSION FOR VESSELS. J. J. Heilmann, Paris, France, 602,325. Filed Dec. 3, 1895. Comprises one or more propellers in each vessel rotated by means of electric motors supplied with current from an electrical generator, which is also carried upon the same vessel.

Railways and Appliances:—

SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. P. J. Pringle, London, England, 602,142. Filed Oct. 26, 1896. Sectional surface contact system.

TRACK WELDING. R. Ryre, Johnstown, Pa., 602,284. Filed Sept. 22, 1897. Combines with the terminals spanning the ends of the rails, dies and contacts, detached from the terminals, and secured directly to the sides of the rails, and an upsetting tool surrounding the terminals and secured to both rails.

CONDUCTOR AND CONTACT DEVICE FOR ELECTRIC RAILWAYS. A. S. Kortz, Springfield, O., W. P. Allen, Chicago, Ill., and O. S. Kelly, Springfield, O., 602,336. Filed May 28, 1897. A contacting device for third-rail electric railway systems comprising a suitably formed body portion having a shoe, a block pivoted thereto, and a resilient supporting piece connected with the block.

Switches, Cut-Outs Rheostats, Etc.:—

AUTOMATIC DEVICE FOR REMOVING RESISTANCES IN STARTING ELECTRIC MOTORS. G. H. Whittingham, Baltimore, Md., 602,413. Filed Sept. 9, 1897. Embodies a centrifugal governor acting to cut in the resistance when the proper speed limit is reached.

Telephones:—

TELEPHONE TRANSMITTER. H. E. Shreeve, Boston, Mass., 602,174. Filed Aug. 26, 1897. Comprises a vibratory diaphragm, and front and back electrodes both mounted thereon, the former being rigidly, and the latter elastically attached thereto, and a variable resistance medium composed of carbon.

PERSONAL

Mr. E. J. Wessels.

The brilliant success achieved by Mr. Wessels in advertising and forcing on a reluctant market a commodity whose genuine merit was only obscured by its high price, led many of his friends to believe that he would ultimately step boldly into the publishing field, and this he has now done. After negotiations for the purchase of one of the oldest and most influential religious journals in this country, Mr. Wessels has put into force one of his pet ideas in the publication of "The Universe," a weekly newspaper of current events, for the young and the busy. It has proved an instantaneous and stunning hit. The chief editor is Mrs. Sydney H. Rosenfeld, whose charm and trustworthiness as a historian of absolute impartiality is well known; and with her are associated many well known people, all of whom tell the news of the day in their respective fields clearly, simply, and plainly, but with literary deftness and with the aid of frequent illustrations. The paper is published at 96 Fifth avenue, New York; 5 cents per week or $2 per year. We can most warmly commend this antidote to yellow journalism to all our readers. It is said that no magazine has ever picked up so quickly such a large subscription list as the clever and solid "Universe." Mr. Wessels bids fair to become one of the best known publishers of good literature in this country.

Mr. Albert A. Cary.

This well known mechanical engineer, so long associated with the technical side of the Abendroth & Root Co., in the development and sale of their Root boiler, has recently taken a very interesting step in severing that connection in order to devote his whole time and all his energies to the Monarch engine stop and automatic speed limit, made by the Monarch Mfg. Co., all of whose product will be exclusively handled by himself and his agents throughout the country. We shall later have an opportunity to illustrate and describe this ingenious attachment in its perfected form. An engine equipped with this device, has one more first-class engineer to look after it, and the lessening of danger and the minimizing of damage if trouble occurs, have already been shown in scores of instances, to be simply wonderful. As an old steam engineering expert, Mr. Cary stands at the head of his profession, and it is significant that he should devote his great abilities to the introduction of this appliance. Friends in every quarter will wish him success.

Mr. E. R. Knowles.

Few men are so well known in the electrical field as Mr. Edward R. Knowles, the electrical, civil and mechanical engineer, and the trade will be interested to learn that he has become identified with the Sprague Electric Company, where he will have entire charge of their Power Motor Department. Mr. Knowles is so well known that it is almost superfluous to say much about him. He is a Californian by birth, but his work and life have been almost entirely in the East, where as an engineer for electrical installations, and later in his specialty of supplying electric motive power to all classes of machinery, and as consulting engineer for the New York and Brooklyn Bridge Company, New York "Journal," and scores of other large corporations, he has attained a very enviable reputation. Mr. Knowles's career as an electrical inventor, and in the developing, perfecting and rendering commercially successful the ideas of others, has been more than noteworthy, and his all round reputation and ability will prove of great value to the Sprague Company. His engagement furnishes additional evidence that the Sprague Company is determined to have the best men in the right place, and both the Sprague Company and Mr. Knowles are to be congratulated on their new alliance.

TRADE NOTES & NOVELTIES

Construction of General Electric Slow and Moderate Speed Generator Armatures.

IN the construction of the armatures of all direct current generators and motors built by the General Electric Co., especial care is taken to produce as perfect and durable a part

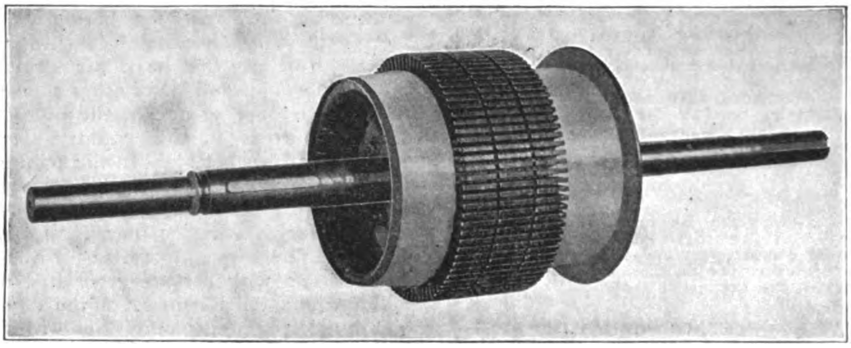


FIG. 1.—IRON CORE OF G. E. ARMATURE.

as possible, without sacrificing any detail essential to efficiency and perfect operation. New ideas have been incorporated, and old and tried features retained; the wire and iron must reach a certain standard of excellence or be rejected; each step in con-

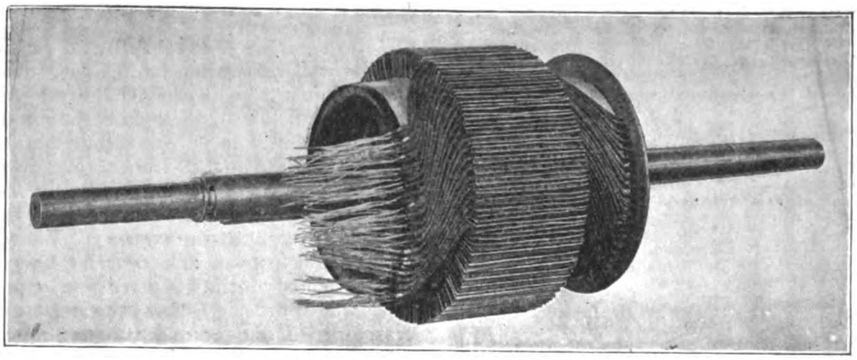


FIG. 2.—METHOD OF APPLYING COILS ON G. E. ARMATURE.

struction is carefully inspected and the completed armature is subjected to a test many times more severe than the severest conditions which would be met with in actual service. Nothing is left to chance.

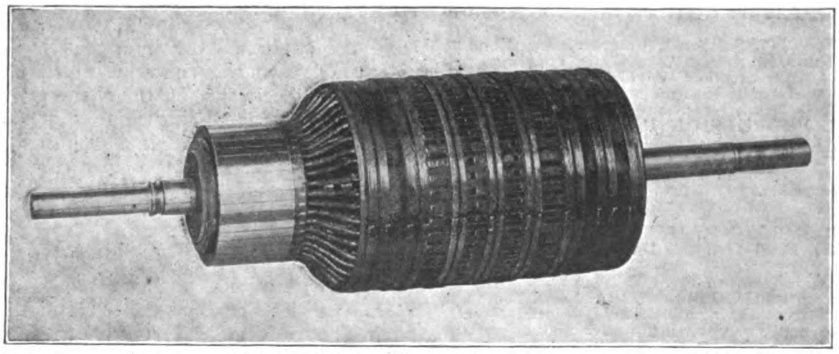


FIG. 3.—COMPLETED G. E. ARMATURE.

In the armatures of the new type of slow and moderate speed direct current generators and motors these characteristic features are strikingly apparent. The completed armature, shown in Fig. 3, is a slotted body of barrel shape, so built that no part is susceptible to movement or vibration. There are no sharp bends to the wire over sharp metallic edges, and each coil is so laid on the core that the outer periphery of the core itself affords it complete protection from mechanical injury.

The spider castings holding the slotted sheet iron laminations are extended into cylindrical flanges at both ends, shown in Fig. 1. The coils previously shaped on a form are laid in the slots, and the ends lie along these flanges at each end of the spider instead of being bent down sharply toward the shaft, see Fig. 2. The coils are formed and insulated before assembling on the core in order that, before application in their final position, they may undergo a careful test, and no coil is used that does not emerge from this with insulation intact. The insulation used is similar to that employed in the G. E. railway motors, and in the operation of these, has given ample proof of its excellent qualities. It is tough, impervious to moisture, and practically indestructible, except under abnormal overload, while it affords high resistance to puncture, rendering injury from lightning extremely improbable. The insulated coils are laid in place in insulated slots in the core and are simply pressed home. The advantage of this method compared with that employed on an armature with the wire wound directly upon it, is obvious.

The cylindrical winding has many positive advantages. A very large radiating surface is provided for the conductors, and this

combined with special air ducts for the passage of currents of air through the core from the interior outwards, tends to keep the armature cool; the length of wire is reduced to a minimum and consequently the losses due to armature resistance are also reduced, while the efficiency of the machine is greatly increased. The complete coil being formed separately and then applied, any one or more coils may readily be removed and replaced.

The coils are firmly secured in the slots on the cylindrical extensions, so that no part can move or vibrate. Indeed, rigidity is one of the most important advantages of the cylindrical winding, since without motion of the parts neither injury nor deterioration of the insulation is likely to occur. The ends of the coils are curved down to the commutator, and the connections are so arranged that open circuiting is impossible. The illustrations show the three different steps in the construction of a General Electric slow and moderate speed generator armature from the completed core to the completed armature.

New Battery Motors of the Kent Electric Manufacturing Co.

THE Kent Electric Manufacturing Company, of Worcester, Mass., who lately have been putting drum armatures into battery motors, are now putting on the market a new motor, which embodies many commendable features and differs greatly from most makes of battery motors. It is very compact, and is of ample proportion and weight, thus giving it great strength

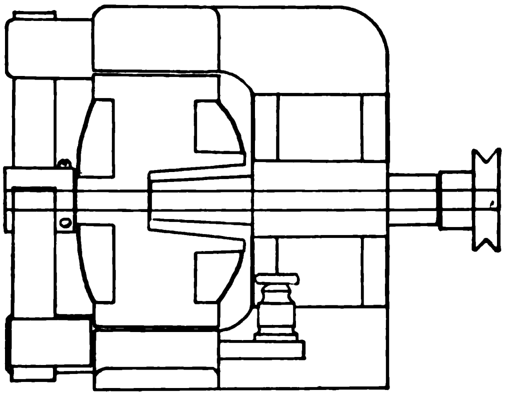


FIG. 1.—CROSS-SECTION OF KENT BATTERY MOTOR.

and capacity. The cross section of the motor shown in Fig. 1 below gives an excellent idea ot its construction.

It has but one bearing, 3 inches long. This bearing is a portion of the field magnet frame at a point where the magnetism is neutral. Thus, the shaft can never get out of alignment or bind, and there are no bearings to adjust. Another advantage which will be appreciated by motor users is that there is no bearing on the commutator end, where the oil will run on to the commutator and prevent the brushes from making good electrical contact. The binding posts are conveniently located by the side of the field coil, and are entirely out of the way.

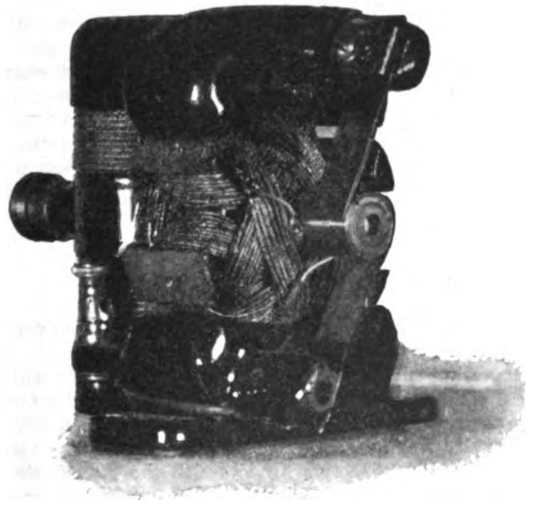


FIG. 2.—KENT BATTERY MOTOR, TYPE C.

This motor is constructed in three sizes, the No. 1, in which the armature is 2 inches in diameter, the No. 2 in which the armature is 2½ inches in diameter and the No. 3 in which the armature is 3½ inches in diameter. These motors are equipped with the company's regular drum armature, which is claimed to do away with the rattling common to three-pole a-matures, as it is not pulled from side to side by uneven distribution of magnetism. This motor, shown in Fig. 2, is designated as Type C.

New Chapman Voltage Regulator.

THE new Chapman voltage regulator consists of three essential parts, viz.: A set of resistance coils to be inserted or removed from the field magnet circuit of the generator to be regulated; a working solenoid to do the work of inserting and removing the coils from the circuit; and an auxiliary solenoid to determine the movement of the working solenoid. The resistance coils are made of German silver, and the size of wire used is such as will afford ample capacity to control the field current of the generator for which it is constructed. The resistance coils are connected to a series of copper segments placed in a horizontal row, and having a contact slider arranged to move over their surface. This contact slider is operated by being mechanically connected to the moving core of the working solenoid. The working solenoid consists of two differentially wound coils of wire placed on a brass tube, one at each end of the tube, and the whole placed in a horizontal position. The middle portion of the tube is left vacant. Inside of the tube is fitted a soft iron plunger somewhat shorter than the distance through the two coils; at the centre portion of the plunger a rod is attached which passes out through a longitudinal slot cut in the vacant portion of the tube. The contact slider above described is attached to this rod and so moves with it and with the iron plunger. In order to prevent too quick a movement of the plunger a very simple and ingenious retarding device is used, in which the moving iron plunger is made to serve the purpose also of an oil pump. From one end of the brass tube to the other a small pipe is connected having a hand valve in it, to regulate the flow of oil. The two ends of the brass tube together with its connecting pipe are completely filled with oil and closed up tight. The movement of the iron plunger toward either end can then take place only as it displaces this oil and causes it to move through the pipe and to the other end. The rapidity of this movement can be very finely adjusted by means of the valve above described.

The force tending to move the iron plunger depends on the balancing of oppositely wound coils against each other, and this balancing is determined by the action of the small auxiliary solenoid, whose only work is to cause one or another of two platinum pointed screws to make contact with the brass lever supporting its core. Contact with one screw causes perfect neutralization of the differential coil at one end of the working solenoid and so disturbs the balance; and causes the plunger to move toward the other coil. Contact with the other screw causes neutralization of the coil at the other end and a movement in the other direction. The small solenoid may be wound to suit a variety of purposes, any one of which may be required in fulfilling the demands of station regulation. It may be wound with a simple fine winding to be connected as a shunt across the lines to be regulated, and in this case it will secure constant potential regulation at the point of attachment to the line. Or, secondly, it may be wound with a fine winding as before and also with a coarse winding. The fine winding is connected as a shunt to the line and the coarse winding is in series with the line. In this case it will regulate for constant potential at some distant point on the line which may be predetermined by the setting of an adjustable compounding switch, provided as a part of the regulator. Or, thirdly, the small solenoid may be wound with a single coarse wire placed in series with the line. In this latter case it will secure regulation for constant current in the lines. But whatever be the nature of the regulation, the small solenoid will perform its duties with an accuracy as close as 1 per cent. above or below the normal, and is adapted to either direct or alternating currents. Alternating currents are especially capable of close regulation by this instrument, as the slight jar incident to current flow through the small solenoid almost entirely eliminates the element of friction at the pivots of the lever supporting the core, and it will easily recognize a change of ½ a volt on a 110-volt circuit. An illustration of the device is shown in our advertising pages.

Eugene Munsell & Co.

Eugene Munsell & Co., of New York and Chicago, are enjoying an excellent trade in their India and Amber "Mica" segments for railway motors. Several heavy orders have recently been received, one of which was probably the largest ever taken for "Mica" segments from an electric railway. It consisted of more than 800 pounds of the India and Amber segments.

The firm carry a large stock of "Mica," both in the sheet and cut to size; and have unequaled facilities, both at New York and Chicago, for executing orders promptly. They will take pleasure in sending samples for trial to any electrical manufacturer, repair concern, or street railway who may write them requesting such samples.

Sprague Elevators for St. Louis.

One of the latest electric elevator contracts awarded the Sprague Electric Company, is for an outfit of ten machines for the Commerce Realty Building, in St. Louis. Says a St. Louis contemporary: "This installation represents a distinct advance in St. Louis in modern installations of this character, and its performance will be watched with interest." The St. Louis order is but one of a large number of out-of-town contracts recently awarded the Sprague Company.

Large Orders For Card Motors.

The Card Electric Company, of Mansfield, O., report the following recent orders for their power, lighting and plating apparatus: One 225 k. w. generator to M. A. Bradley, Cleveland, O.; two 30 h. p. motors to Raton Coal & Coke Co., Raton, N. M.; one 100 k. w. direct connected generator and one 5 h. p. motor to the Cleveland Shipbuilding Co., Lorain, O.; two 30 k. w. generators to A. A. Gardener, Myers, Fla.; one 75 k. w. generator, one 50 h. p. and one 15 h. p. motor to A. Trostel & Son, Milwaukee, Wis.; two 20 h. p. motors to the Cambridge, O., Iron & Steel Co.; one 40 k. w. direct connected generator to Herman Zohrlant Leather Co., Milwaukee, Wis.; one 30 h. p. and one 15 h. p. motor to Chicago City Ry. Co.; eight electric plating dynamos to Bennett & O'Connell, Chicago, Ill.; one 10 h. p. elevator motor to Voegle & Dinning, Mansfield, O.; one 100 k. w. direct connected generator to Ohio & Pennsylvania Coal Co., Cleveland, O.; one 15 k. w. direct connected generator to Wadsworth Salt Co., Wadsworth, O.; one 20 k. w. generator and one 5 h. p. motor to P. H. Trout, Jr., Stanton, W. Va.; one 7½ h. p. and two 5 h. p. elevator motors to J. H. Reedy, Cincinnati, O.; one 15 h. p. motor to Wm. Mullens, Davenport, Iowa; one 100 generator and one 100 h. p. motor to Harter Milling Co., Fostoria, O.; one 30 k. w. direct connected generator to J. H. Wade, Cleveland, O.; one 150 k. w. generator to Elwood, Ind., St. Ry. Co.; one 75 k. w. direct connected generator to J. P. & J. S. Jett, Carrollton, Ky.; one 25 h. p. motor to Johns & Co., Cleveland, O.; one 15 h. p. motor to Jacob Dold Packing Co., Buffalo, N. Y.; one 15 h. p. motor to National Carbon Co., Cleveland, O.; one 15 k. w. generator to Cincinnati House of Refuge; one 40 k. w. generator to Phalanx Silk Mills, Jersey City, N. J.; one 15 k. w. direct connected generator to U. S. Government Light House, Detroit, Mich.; one 50 k. w. generator and one 20 h. p. motor to Wolverene Mfg. Co., Detroit, Mich.; one 7½ k. w. generator to McCullen & Cook, New Orleans, La.; one 7 k. w. generator to Hawee Bros., Springfield, Mass.; one 20 k. w. generator and one 10 h. p. motor to A. J. Root, Medina, O.; one 25 k. w. generator to Flint & Lomax, Denver, Col.; one 40 k. w. direct connected generator to Kieffer & McArthur, Mt. Clemens, Mich.; one 10 h. p. motor to John Christie, Green Bay, Wis.; one 10 h. p. motor to W. S. Carter, Jackson, Mich.; one 10 h. p. motor to Keelyn & Smith, Milwaukee, Wis.; one 3 h. p. motor to C. F. Ganshow, Saginaw, Mich.; one 3 h. p. motor to W. E. Bridegram, Reading, Pa.; one 7½ h. p. elevator motor to Tracy & Avery, Mansfield, O.; one 30 k. w. direct connected generator, one 15 k. w. belted genrator and one 20, one 10, one 7½ h. p. motors to Deen & Schaum, Lancaster, Pa.; one 5 h. p. elevator motor to H. S. Long, Marion, O.; one 15 h. p. generator to J. S. Turner, Springfield, S. D.; one 35 h. p. motor, Citizens Elec. St. Ry. Co., Light & Power Co., Mansfield, O.; two 4 k. w. generators to Geo. Haucke, Springfield, O.; one 40 k. w. generator, two 10 h. p. and one 5 h. p. motor to the Ohio Brass Co., Mansfield, O.; one 7½ h. p. elevator motor to Eaton & Prince, Chicago, Ill.; one 20 k. w. generator to C. I. Case, Cleveland, O.; one 5 h. p. motor to T. P. Ford, New York, N. Y.; one 10 h. p. motor to Turner Engineering Co., Marion, O.; one 3 h. p. motor to Speers & Winfield, Youngstown, O.; one 5 h. p. motor to J. F. Wider & Son, Saginaw, Mich.; one 25 h. p. motor to Ship Owner's Dry Dock Co., Cleveland, O.

Sprague Electric Co. Dividend.

The Board of Directors of the Sprague Electric Company have declared a dividend of 3 per cent. on the preferred stock payable on May 2 to shareholders of record of the 18th instant.

CATALOGUES.

The Pelton System of Power.

AN exceptionally useful, instructive and artistic catalogue has recently been issued by the Pelton Water Wheel Co., of San Francisco and New York. It contains a hundred pages, is richly illustrated, and may be called a text book on hydraulic engineering. The introductory chapters of the book contain valuable information on the use of water power for transmission purposes and the means for utilizing such powers to good advantage. Among the numerous tables presented in the book, those giving the horse power, cubic feet, miner's inches and revolutions for any size wheel and head in feet, tables for calculating the horse power of water, loss of head in pipes by friction and weir measurements, deserve special mention. A list of 125 installations, which vary exceptionally as to head and variety of service, is given, and numerous plants are described in detail. As stated above, the catalogue is profusely illustrated with halftone cuts to show the apparatus of the company, and also with a large number of line cuts to illustrate the text, which is so admirable a feature. The company is to be congratulated on the merits of its literary production.

Test of the Power Plant of the Brockton Street Railway Company.

The above is the title of a very complete and instructive pamphlet issued by Messrs. Stone & Webster, electrical experts and engineers, 4 Post Office Square, Boston, Mass., which contains the results of tests they have made for the purpose of determining whether the specifications for the extension of the Brockton Street Railway Co.'s power plant had been properly met. The pamphlet contains the details of tests to obtain the evaporative performance, commercial horse power and rate of combustion and evaporation of the boilers, speed regulation, power and efficiency of the engines, and the efficiency, capacity and temperature under load of the generators. A number of illustrations and curves accompany the report and the results show that the requirements of the specifications had not only been met, but had been surpassed, which certainly reflects much credit on the engineers in charge of the work.

Spague Electric Company.

The high class catalogues issued of late by the Sprague Electric Company, 20 Broad street, New York, have already won for that enterprising firm much well deserved praise and commendation. The typographical work and general appearance of the literature issued by this company is of the highest class and does justice to the excellence of their products. Two catalogues, one entitled "Electric Motors and the Art of Printing," the other illustrating the Lundell fan motors, have just reached our office, and are certainly masterpieces of the engraver's art. They are, one might say, text-books on the subject of which they treat, and the text is complete in every particular, including the illustrations. Types of Lundell fan motors are described, principal among which may be mentioned the column fan motor with umbrella stand, which will certainly commend itself to the general public.

Eastern Electrical Supply Company.

The Eastern Electrical Supply Company, of 26 Cortlandt street, New York, have just issued a very neat and attractive descriptive catalogue and price list of electrical supplies which they manufacture. The list includes a great variety of electrical supplies such as cut-outs, ceiling rosettes, sockets, push and knife switches, panel boards, wire guards, chandeliers, carbons, incandescent lamps, measuring instruments, fan motors, bells and fire alarm boxes. The catalogue is profusely illustrated, and has a very complete index.

Holtzer-Cabot Electric Company.

A very complete and handsome descriptive catalogue of magneto bells, power generators, desk telephone sets, interior telephones, telephone annunciators, receivers, transmitter arms, and other telephone apparatus, has just been issued by the Holtzer-Cabot Electric Company, of Boston, Mass. The catalogue contains a large number of illustrations, showing the high grade goods manufactured by this company, and they advise their patrons to investigate well before they purchase, for experience gained by mistakes is very costly. A new motor and dynamo catalogue is now in preparation, and will be issued shortly. A number of circulars devoted to general electrical supplies and fan motors have also been issued of late, which will be sent to the trade upon application.

Armington & Sims Company, Providence, R. I.

These well known engine builders have just issued a very handsome catalogue of the great variety of sizes and types of engines, which they manufacture to meet the requirements of any service. The 1898 pattern Armington & Sims high speed engine embodies among the most important improvements: Adjusting cylindrical or piston valve, the Rites inertia governor, a very efficient oiling device, all of which are illustrated and described in detail. The catalogue contains tables and price lists of the various types of engines; condensing, non-condensing, simple, compound, and cross compound, and the second portion of the catalogue is devoted to a description of direct-connected engines. Over 5,100 Armington & Sims engines are now in successful operation, which is convincing evidence of their superiority, the result of thorough methods and careful attention to details in every department.

The Queen Acme Testing Set.

The chief advantages of this well known instrument manufactured and sold by Queen & Co., Inc., 1010 Chestnut street, Philadelphia, Pa., are the accuracy attainable and its portability, its extremely wide range of measurement and its freedom of error or derangement. The instrument is the result of the continual effort on the part of the company to incorporate these essential features in a thoroughly practical form of resistance box, ranging from one hundredth of an ohm to one megohm, which can be accurately measured. The coils are wound with platenoid wire carefully seasoned; there are sixteen coils in all, their total resistance being 11,110 ohms. The galvanometer is of the well known D'Arsonval type, and the battery consists of six chloride of silver cells. The company has recently issued a catalogue which fully describes this instrument and methods of using it, and gives a complete list of other catalogues issued by Queen & Company.

Colt & Co.'s Lantern Slides.

J. B. Colt & Company have earned for themselves so enviable and well deserved a reputation that their timely action of preparing a series of current topic lantern slides is not at all surprising. This latest series contains such subjects as The Maine Disaster, Cuba and Her War, Vessels and War Ships of Spain and the United States, Sailor Life in the United States Navy, and the Manners and Customs of the Cubans. A catalogue illustrating a great variety of these timely subjects, enumerating in all 455 slides, must certainly be of timely interest and great value to lecturers and societies. The executive offices of the firm are at 115-117 Nassau street, New York, and after May 1 at 3-7 West Twenty-ninth street. Branch offices are located at 189 La Salle street, Chicago, Ill., and 131 Post street, San Francisco, Cal.

The Murray Iron Works Company's Tubular Boilers.

The many advantages of the high pressure modern tubular boiler are ably set forth in the catalogue of the Murray Iron Works Company, Burlington, Iowa. Five styles of boilers manufactured by this company are illustrated and give the reader a good general idea of the product of this well known concern.

ADVERTISERS' HINTS

THE WHEELER REFLECTOR CO., Boston, Mass., invite their customers to specify where they want the light and guarantee to send them a reflector to suit each condition.

THE CROCKER-WHEELER ELECTRIC CO., 39 Cortlandt street, New York, after having considered the requisite features of a motor for elevator service have designed and introduced one which they are sure will prove an unbounded success.

THE WALKER CO., Cleveland, Ohio, are advertising trolleys.

THE ELECTRICAL EXHIBITION CO., 15 Cortlandt street, New York, have but little space left for sale, and advise those who wish to secure it to do so at once, as in a very few days every inch of it will be sold.

THE SHELBY ELECTRIC CO., Shelby, Ohio, advertise incandescent lamps of all voltages and candle powers.

THE STANDARD PAINT CO., New York, have found it necessary to open an office in Hamburg, Germany, to take care of their constantly increasing business in that country.

VISITORS TO THE EXHIBITION will find the Gilsey House and the Sturtevant House both within convenient distance of the Madison Square Garden.

THE KEYSTONE ELECTRIC CO., Erie, Pa., are advertising their type "H" enclosed steel motors which they state are fireproof, waterproof, slow speed and noiseless.

THE CHAPMAN VOLTAGE REGULATOR has given great satisfaction in many plants, if we judge by the many testimonials we have seen regarding its efficiency. Another feature worth considering is the saving in attendance. The Belknap Motor Co., of Portland, Me., are the manufacturers.

THE LYNN INCANDESCENT LAMP CO., Lynn, Mass., offer to buy up burned-out lamps at three cents each.

THE NORDEN ELECTRIC CO., 145 West 28th street, New York, are ready to assist exhibitors in getting ready their exhibits. They undertake wiring construction work, supply electric signs, incandescent lamps, arc lamps, sockets, switches, etc.

INTERIOR TELEPHONES are advertised by the Allen-Hussey Co., 213 Randolph street, Chicago. They issue illustrated descriptive circulars.

THE ELECTRIC STORAGE BATTERY CO., Drexel Building, Philadelphia, Pa., state that a decrease in the cost of production and an increase in earning power has been brought about by the use of the "Chloride Accumulator" in central lighting and power stations.

THE HIGH TENSION STORAGE CO., Heed Building, Philadelphia, Pa., are prepared to furnish batteries in all sizes from portables to station batteries of 5,000 ampere hour capacity.

KENT ELECTRIC MFG. CO., Worcester, Mass., advertise drum armature battery motors which are fully described elsewhere in this issue.

THE GARVIN MACHINE CO., New York, have ready for immediate shipment a large stock of shapers in all sizes and styles.

THEO. AUDEL & CO., 63 Fifth avenue, New York, advertises Hawkins's works on the steam end of electricity.

THE HART & HEGEMAN MFG. CO., Hartford, Conn., advertise porcelain clad Hart flush switches.

MR. M. A. SINGER, 27 Bond street, New York City, is already busy on a number of contracts for booths and decorations for the Electrical Exhibition. He says the results will be unusually fine. Among those he is now working on are the spaces for Henry R. Worthington, Thos. A. Edison, Jr., Zimdars & Hunt, Ideal Elec. Corporation (F. A. La Roche & Co.), Fuel Economizer Co., H. B. Coho & Co., Am. Elec. Novelty Mfg. Co., "Electricity" newspaper and Burrows Electric Horseless Carriage.

NEW YORK NOTES.

E. B. LATHAM & CO. report an increase in demand for the sale of the Tuerk alternating current ceiling fans for foreign countries, having received unusually large orders from France and South America.

F. A. LA ROCHE & CO., 652 Hudson street, New York City, are the successors to the Ideal Electric Corporation, and assume all liabilities. The concern are busy on a large run of work in all lines.

ALFRED DOLGE & SONS. General and deep regret is felt at the receivership appointed for this firm, whose enterprise in the felt industry has built up Dolgeville, in regard to whose development by electric power a long article appeared recently in The Electrical Engineer. The nominal value of the assets is $1,150,000. The debts and liabilities may reach $700,000.

DE VEAU & CO., the manufacturers of telephone and equipment supplies, 27 Rose street, New York, have an order from the Government for telephones for a merchant ship just purchased, to be turned into a man-of-war.

MR. S. BERGMANN, of the Incandescent Arc Light Co., of this city, has sailed for Europe to look after his important interests there, and Mr. Samuel Insull, who is a stockholder in the concern, has taken the vice-presidency of the concern. We understand that the company, which has been remarkably busy, is now getting ready to go into the small dynamo and motor business, with an unusually fine line of apparatus.

NEW ENGLAND NOTES

MR. H. H. BROOKS, of the American Circular Loom Co., of Boston, who has been for the past five months in New Mexico, on account of his health, has now returned to Boston fully restored to his usual good health and spirits. Mr. Brooks is one of the most popular men in the electrical business and his numerous friends will doubtless be glad to see him again among them. Most probably before long he will be taking a little trip through the country in the interests of flexible conduit, and after his pleasant rest in the South for so many months he should be in good condition to take advantage of increasing business.

MERRIMACK CHEMICAL CO., 13 Pearl street, Boston, Mass., report their works at South Wilmington, Mass., very busy. They manufacture acids and chemicals for every purpose in the electrical line, and especially for storage battery uses. Correspondence is solicited from all consumers and dealers using Merrimack Chemical Co.'s products.

SWETT & LEWIS, 11 Bromfield street, Boston, make a specialty of static machinery for Röntgen ray and therapeutic work. They report shipping goods on orders as fast as they can make them.

L. E. KNOTT APPARATUS CO., Ashburton Place, Boston, are sending out to the trade their new catalogue of X-ray apparatus and their general line of philosophical instruments.

WESTERN NOTES

WASHBURN & MOEN, Worcester, Mass., have taken a large contract in St. Louis for all the lead-covered underground cables required in the new system of the Imperial Electric Light, Heat and Power Co. They have many large cable contracts on their books, including one for lead cables for the West Park system, Chicago; and another for high voltage lead cables to be used in conveying the current from Chambly Rapids to Montreal, to be used in that city for light and power.

COLUMBIA INCANDESCENT LAMP CO., St. Louis, report that they have never had a better business than at present. It shows a 50 per cent. increase over the corresponding period of last year.

MR. W. R. GARTON, 414 Ashland Block, Chicago, has just completed arrangements with the United Electric Improvement Co., of Philadelphia, to represent all their products in Chicago, devoting special attention to their high grade incandescent lamps. He will also push their direct and alternating current dynamos and motors, and expects to build up a large trade in the U. E. I. specialties.

SHELBY. The enormous demand for Shelby incandescent lamps, the product of the Shelby Electric Co., of Shelby, O., has caused them to increase their capital stock from $100,000 to $250,000. Plans have been drawn for a large addition to their present plant which will more than double their present capacity. The success of this company is largely due, not only to an excellent product, but to the efforts of Mr. John C. Fish, secretary of the company, whose originality and enterprise are well known to the trade.

PHILADELPHIA NOTES

SCOTT & JANNEY ELECTRIC MFG. CO. have removed their factory from Filbert street to Washington avenue and 22d street, where they have much better facilities for handling the large alternating current machinery which they are now turning out. They also have their own foundry which is directly connected with the main railway line by special tracks running into the yards of the company.

CONTENTS.

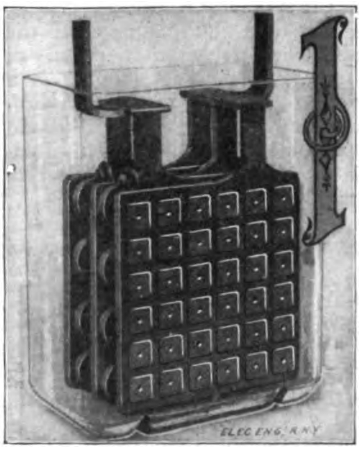
Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. APRIL 28, 1898. No. 521.

THE ELECTRIC STORAGE BATTERY CO.—ITS FACTORY AND ITS BATTERY INSTALLATIONS.

BY JOSEPH WETZLER.



IT was in 1881 that the steamship "Labrador" brought to this country the first storage cell, constructed on the Faure plan. Its arrival was very properly hailed as a notable event by electricians and scientists generally. The expectations of all had been raised to a high pitch by the glowing accounts given of the Faure cell by Lord Kelvin, but it is safe to say that if the expectant ones on this side of the water had known how the cells on the "Labrador" had to be guarded, and indeed, fairly nursed, to keep them from falling apart during the voyage, their enthusiasm would have received a severe setback. We can all well afford to smile at this bit of inside history now, and it has been referred to only to bring out into stronger contrast the great developments since made—developments which enable the shipping of battery plates in open crates across the Continent without the slightest danger of their coming to harm.

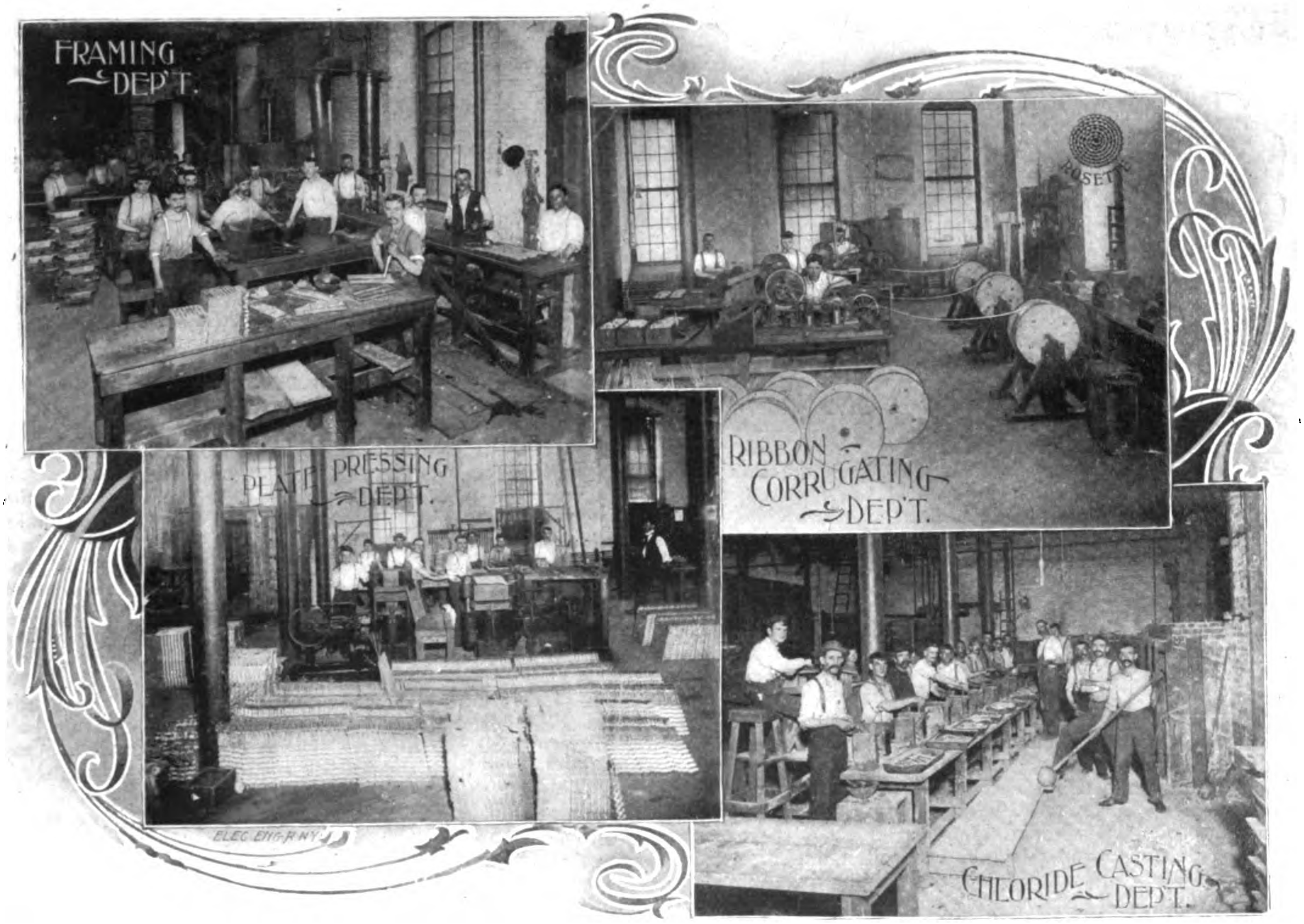
Nor need we here allude to the other technical improvements which have lifted the storage battery out of the electricians' slough of despond and placed it among the "sure-enough" materia electrica—to borrow, or rather paraphrase, a familiar term. Suffice it to say that the storage battery, after many vicissitudes, especially in America, is now acknowledged to be a most valuable, and in many instances, an indispensable, adjunct to economical electrical operation, and that its influence is growing from day to day. This recognition has resulted in an impetus to the storage battery industry such as it has not experienced since its establishment in the United States.

The dawn of this new era of activity in storage battery work seems to be well worth emphasizing by a glance at the present state of the art in America as embodied in the methods of manufacture pursued, and as represented by some typical plants installed by the Electric Storage Battery Co.

At the request of the writer, the company, a few weeks ago, very courteously threw open for inspection every department of its great works in Philadelphia, and the following account is the record of a most interesting and profitable experience.

THE FACTORY.

Before entering into a description of the processes of battery manufacture, it may not be out of place to refer to the structure in which they are carried on. This is the great six-story Worden Power Building, in Philadelphia, situated at the intersection of Allegheny avenue and 17th street, right between the Pennsylvania and the Philadelphia & Reading Railroads, from both of which spurs run directly to the doors of the factory, the cars passing into the central court yard between the two wings of the great building. This location is therefore preëminently adapted for rapid and easy shipment of the finished product—a not unimportant item in any case, but particularly



so in the present instance, where the material necessarily runs to such heavy weights. With this brief glance at the building, we pass in at the door of the office entrance and are soon ushered into the private office of Superintendent Potter, who very kindly offers to take us over the works in person, and whom we will follow as he passes from one department to another and brings us face to face with the scenes depicted in the views accompanying this account.

THE POSITIVE PLATE.

Entering a side door we step at once into the department devoted to the preparation of the positive plates. Broadly described, the positive plate of the "Chloride" accumulator, Manchester form, consists of an active material of peroxide of lead, formed after the Planté method on a rosette or coil of rolled lead tape, corrugated and coiled automatically, and pressed into an antimonious lead frame or grid, which makes a practically non-corrodible, rigid and conductive support.

The first intimation of the positive plate in the factory is the arrival of a car-load of antimonious lead, which is immediately unloaded from the siding, and a sample of which is at once sent to the chemical laboratory for analysis, in order to determine whether or not the lead in question is up to sample.

The lead for daily use is weighed and fed to the melting pots, which are fired by oil and hold about four tons each. The moulds for the positive plate are made of cast iron, with steel buttons corresponding to the holes which are required in the grids. These moulds are hinged, and the feed is orificed to fit a nipple which is connected to a very ingenious lead pump, designed and patented by Mr. Herbert Lloyd, the general manager. Great difficulty was experienced, originally, in securing a valve which would hold the molten lead at the pressure required, but the above scheme of Mr. Lloyd's has worked to perfection for the past eight years.

The air pressure is admitted to the pump by means of a three-way valve, and the grid is cast under a pressure of about one hundred pounds to the square inch. These grids are trimmed and then stored in the Manchester Department, ready to be filled.

The lead ribbon which is, eventually, to become the active material, is received on reels in the form of lead tape, and is fed into the coiling machine, the function of which is to corrugate and cut it into proper lengths and coil it into rosettes of the required size. This machine was designed by Superintendent Potter, to whose skill are due many of the labor-saving devices employed in the works.

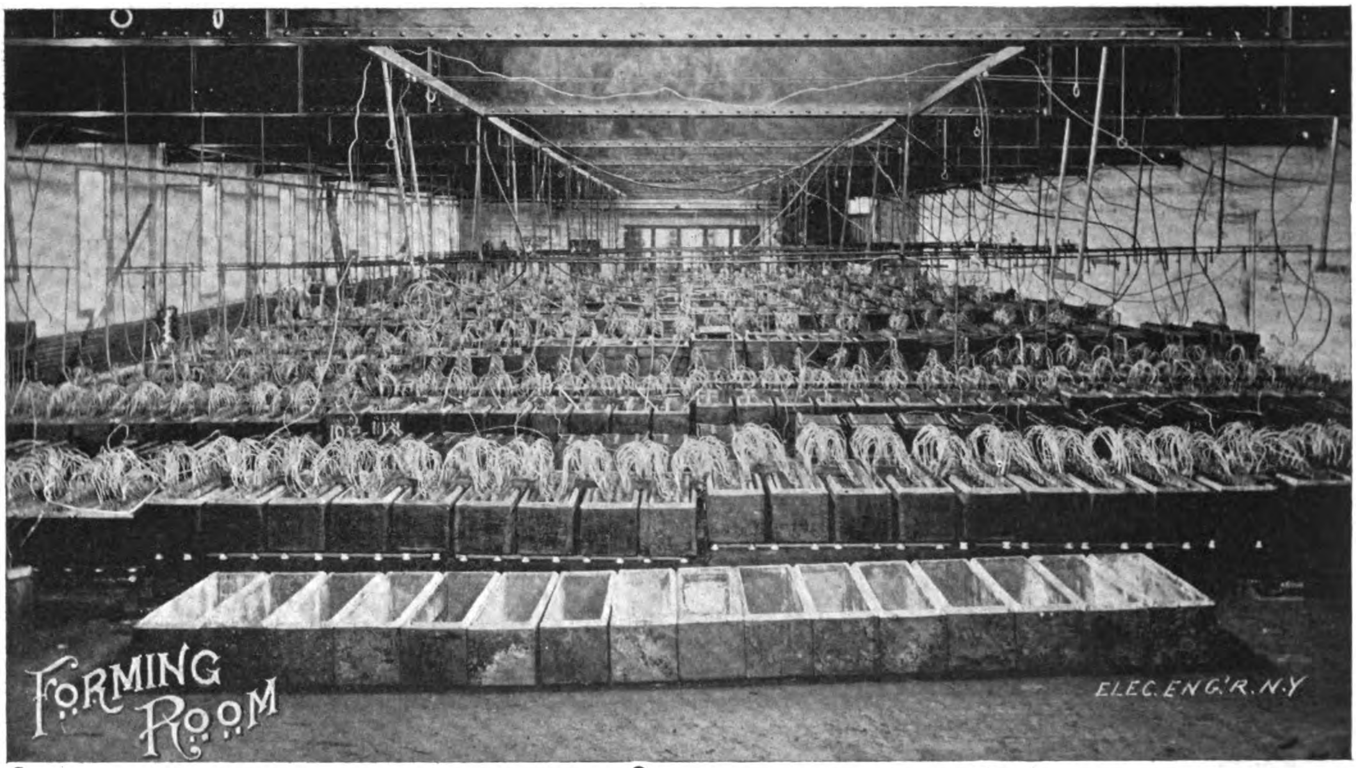
Formerly the rosettes were made by corrugating the ribbon and cutting it by hand, the coiling being done by putting one end of a length of ribbon between two pins on the armature spindle of a small motor, which was started by touching a foot button. In this way a smart boy could make about eight thousand rosettes per day. The above machines do the work of forty or fifty boys.

The rosettes are placed in templates and are driven into the grids by hydraulic pressure. The plates are then ready for forming.

THE FORMING DEPARTMENT.

The forming is carried on in a model building opposite the main building, constructed on principles arrived at after years of experience in rooms of every description. The building is a one-story structure of cemented brick, with a monitor roof, which gives ample light and ventilation. The roof is of wood covered with lead-coated sheet iron, which is painted with acid-proof paint. The floor is made of highly vitrified brick, set in pitch and grouted with the same material.

The forming room, shown on this page, is 60 feet wide and 120 feet long, and the floor has a drop from back to front of one-half inch to the foot, thereby thoroughly draining the floor into a gutter one foot wide, which is also heavily pitched, to five drains connected up to a parallel pipe outside of the building; so that any drains that may need repairing are easily reached from the outside, without disturbing the floor.



The forming tanks are arranged in lines running across the room; a series consisting of twenty of the largest sized tanks across and twenty back; this arrangement allowing of the use of a minimum amount of wire in the forming room. The connections between the tanks are made of specially compounded solder. Mercury was formerly used, but considerable trouble, as well as waste, was experienced owing to the spilling of this material and the amalgamation of the copper and lead connecting the wires.

After the forming process, which occupies several days, the plates are taken out and examined, and a sample of one-half dozen from each four hundred sent to the Commercial Laboratory, for test, and the balance trucked to the store room, being then ready for shipment.

The electrical energy used in the forming room is generated in the engine room, about 200 feet away; the supply being drawn from three 75 kilowatt General Electric generators, belt driven from three 100 h. p. Westinghouse engines; one 50 kilowatt Siemens & Halske; one 75 kilowatt Electro Dynamic Co.; and one 30 kilowatt Eddy generator.

The cables carrying the current are run underground to the

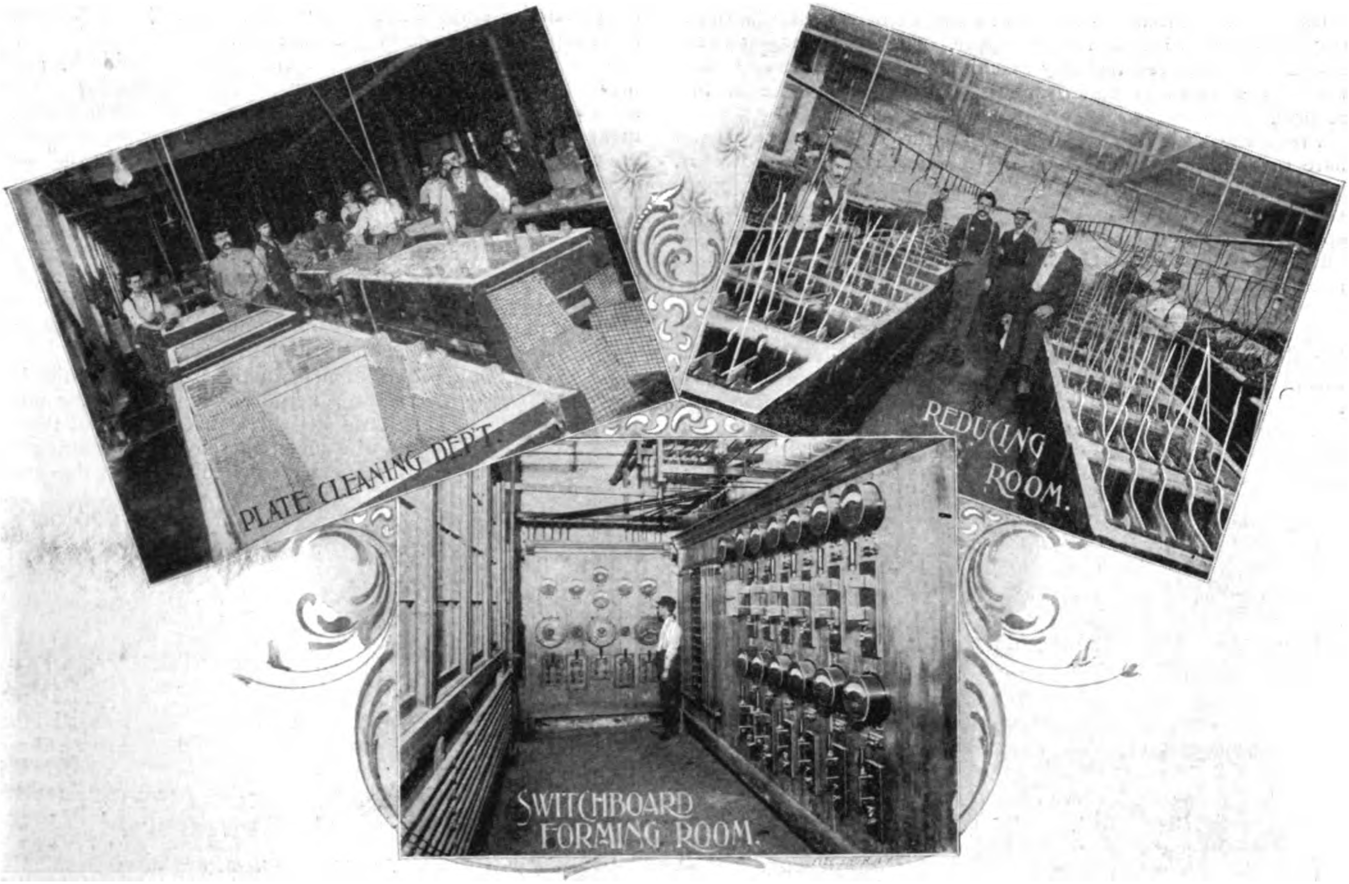


PLATE CLEANING DEP'T.
REDUCING ROOM.
SWITCHBOARD FORMING ROOM.

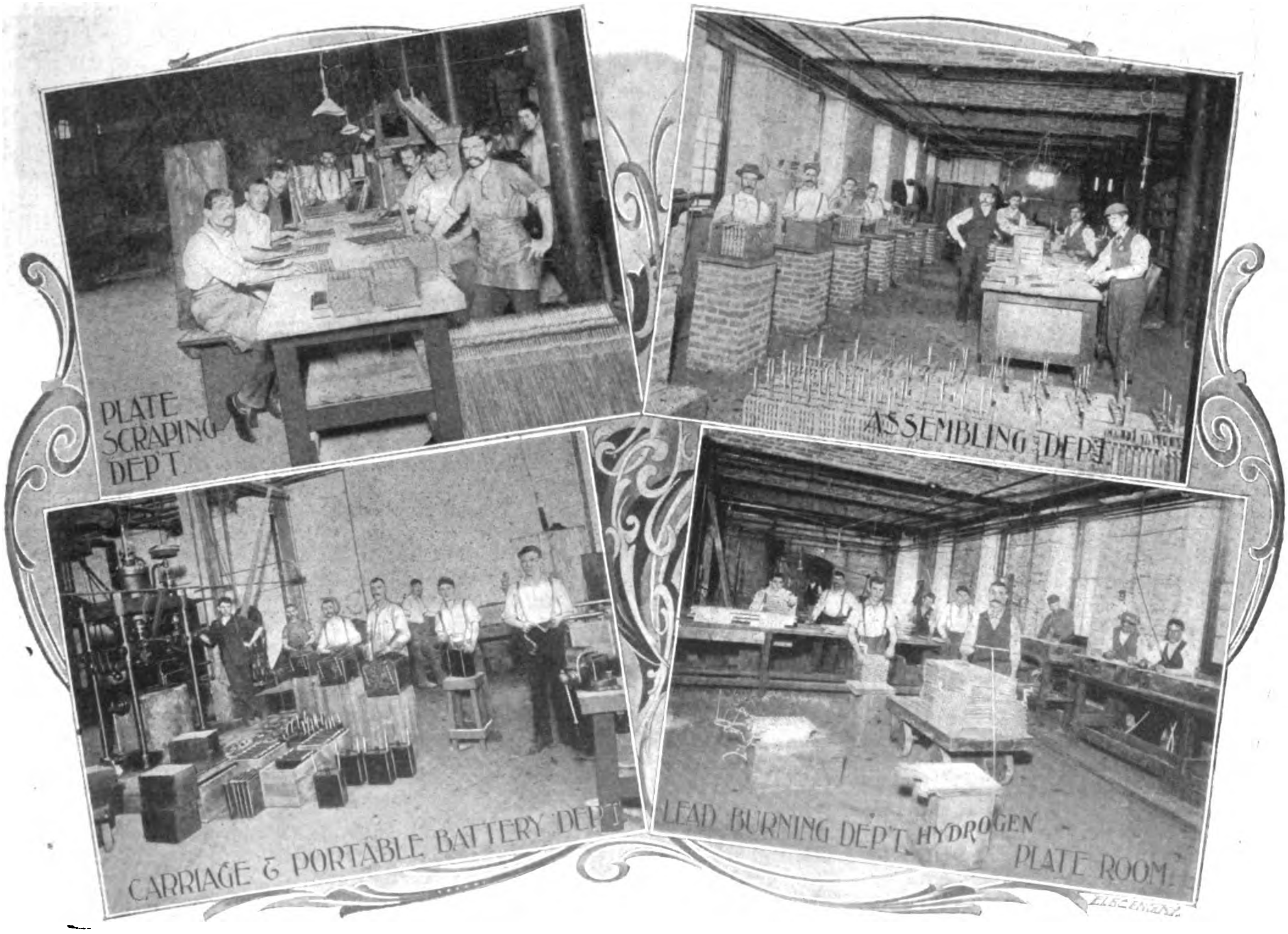


PLATE SCRAPING DEP'T.
ASSEMBLING DEP'T.
CARRIAGE & PORTABLE BATTERY DEP'T.
LEAD BURNING DEP'T.
HYDROGEN PLATE ROOM.

forming room dynamo switchboard and thence to the distributing switchboard through bare copper. The distributing switchboard is so arranged that any machine can be used for any combination of rows of tanks, and is particularly flexible in this respect.

From the distributing switchboard the copper wire is run bare throughout the length of the forming room in a corridor, and the leads pass through the partition in the corridor opposite each row of tanks. This corridor protects the copper and special controlling resistance of tin strips, which are supported on slate and iron brackets, from the effects of the forming room fumes.

THE NEGATIVE PLATE.

The negative plate is composed of pastilles of chloride of lead, keyed together with a frame of antimonious lead, which is forced around them. From this chloride, the name "Chloride Accumulator" is derived.

The chloride is manufactured at the company's Camden factory, and is shipped daily by team, as it is wanted. It arrives at the Philadelphia factory in the shape of white crystalline powder, 100 per cent. pure. The chloride is shoveled into the reverberatory furnaces, which hold about one ton each. When melted, which process requires a great heat, the chloride is ladeled into casting moulds, making square pastilles of four square sub-divisions, divided by two small grooves on each side perpendicular to each other. At the intersection of each in the middle of the pastille is left a hole.

The pastilles, after being trimmed, are conveyed by means of a conveyer to the framing moulds, which are similar in construction to the positive moulds, and are placed by hand in the mould, being held in position by countersunk recesses and small pins. When the mould is filled, the lead pump is again brought into play, and the result is the framed negative in chloride form.

The plate has the superfluous lead scraped from it, and is then sent to the "reducing room." There it is placed between sheets of zinc in an electrolyte of chloride of zinc, thereby eliminating the chlorine from the chloride and reducing the pastille to a very porous, crystalline mass of spongy lead, the crystals of which lie transversely to the plane of the plate, and are beautifully pronounced, being plainly seen by the naked eye.

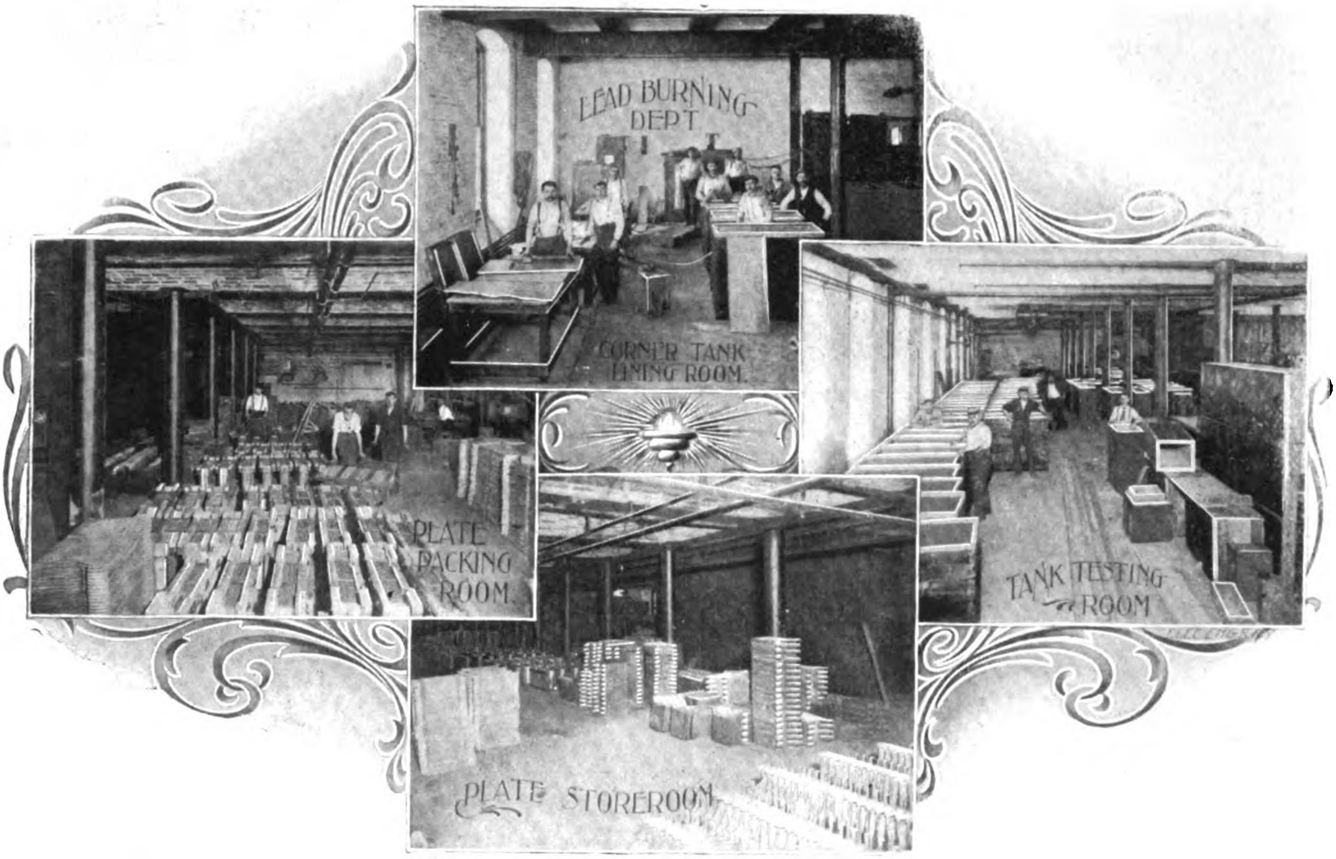
After this process, combined with several washings, the negatives are taken to what is known as the cleaning department, where they are placed in tanks as cathodes to the current, which is applied for several hours; this being merely a test to insure the entire elimination of the chlorine.

From the reducing process is obtained a valuable by-product in the shape of chloride of zinc, of 50 deg. Baumé. This is stored in drums and shipped as sold. From the cleaning department the negatives are trucked to the stock room, whence they are sent to be assembled, or shipped "knocked down," as the case may be.

The smallest plate kept in stock is the size "B," and every size, according to letter, is double in surface and consequently in capacity to that of the preceding letter. The largest plate yet made is the "H," which consists of two "G" plates (16 inches x 16 inches) burned together; this joint makes a solid antimonious lead seam and is as perfect as the rest of the plate; see page 458.

THE ASSEMBLING DEPARTMENT.

The assembling room, situated in the basement of the building, is the scene of the introduction, as it were, of the positive to the negative plates. And it is here that the lug of the strap is burned to the lug of the plate, thereby incorporating them into an element. This process is carried out with the greatest care, making a perfectly homogeneous weld, as no other metal than that of the respective parts is used. For the burning a pure hydrogen flame is employed, which leaves the surface of the melted metal pure and unoxidized. The hydrogen employed for the purpose is made on the premises and stored in a large tank, constituting, in fact, a small gasometer. The proper quantity of air is supplied by a Root blower.

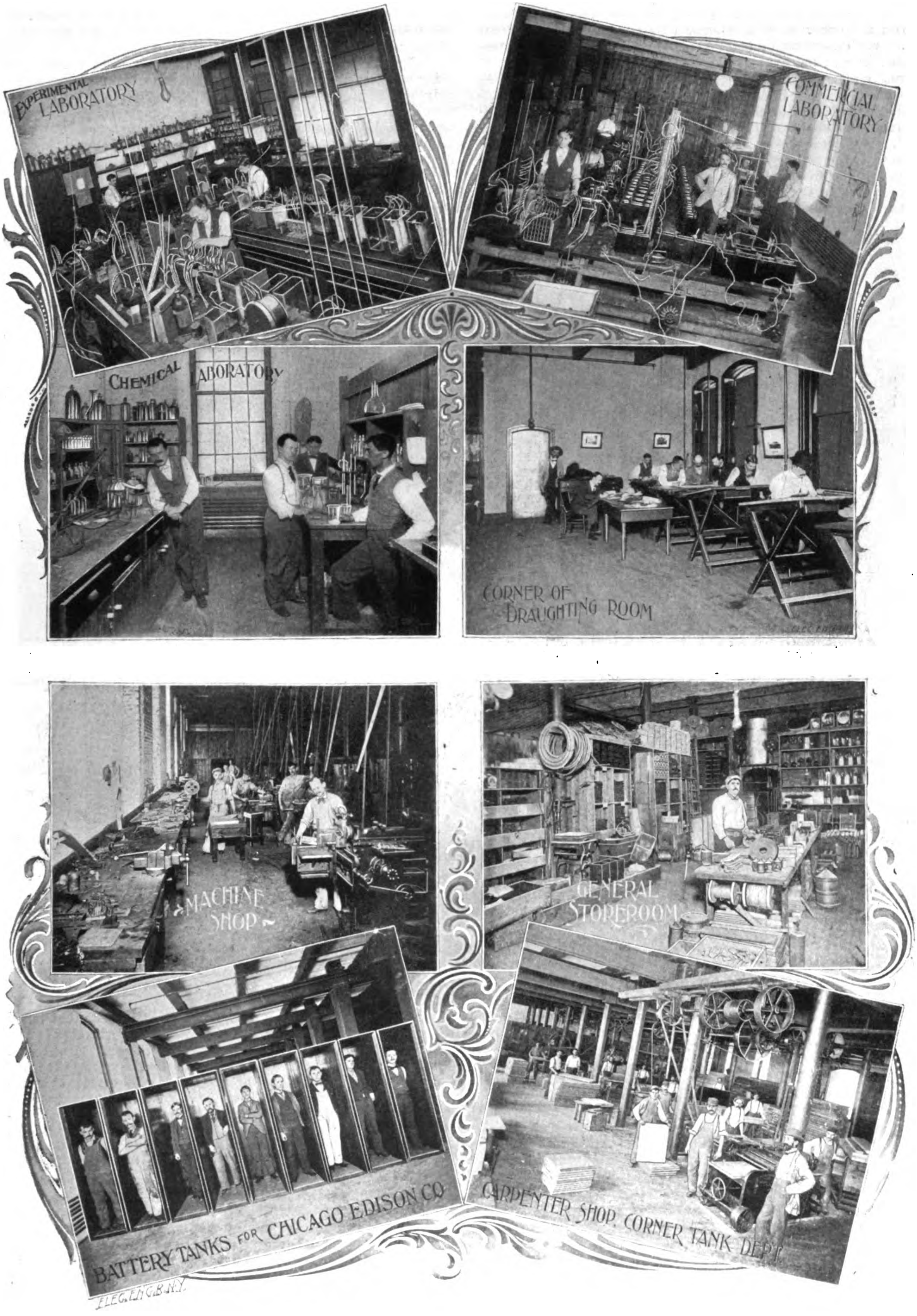


After the burning or welding process is completed, the elements are taken to the packing department and shipped thence to their destinations.

In the sealed cell department is conducted the assembling and putting up of all kinds of portable batteries for phonographs, automatic pianos, sewing machines and many other purposes too numerous to mention. These elements are encased in rubber jars, and are then fitted in well-finished and highly polished hardwood boxes, which are provided with convenient handles.

THE CARPENTER SHOP.

There are several departments, which, while they have no direct bearing upon the manufacture of the plates, are quite essential. Of these the most important is the carpenter shop, in which the tanks are made. In this department the company uses thousands of feet of the best quality of ash lumber, varying in thickness from seven-eighths to two inches. The Electric


EXPERIMENTAL LABORATORY
COMMERCIAL LABORATORY
CHEMICAL LABORATORY
CORNER OF DRAUGHTING ROOM
MACHINE SHOP
GENERAL STOREROOM
BATTERY TANKS FOR CHICAGO EDISON CO
CARPENTER SHOP, CORNER TANK DEPT.
ELEC.ENG.N.Y.

Storage Battery Company, in fact, are now the largest consumers of lumber in Philadelphia, a by no means unsignificant fact, considering that Philadelphia is one of the largest manufacturing cities in the country.

This lumber is procured directly from the logging camps in the rough, being carefully selected at the points from which it is shipped. It is received in carload lots and is deposited in the carpenter shop on the second floor, by means of a lumber hoist. The latter consists of a square link chain, with projecting feet at the proper intervals, the lumber being placed upon these and run to the second floor; power being supplied by a pulley belted to the main shaft.

The planks in the rough are cut up into the various lengths, according to the size of the tanks to be made, and are then run over a joiner. Where larger sized tanks are required, the sides are made in two pieces, which are fastened together with dowels and glue; they are then run through a planer and smoothed up. The sides and ends are dovetailed by means of specially designed dovetailing saws. The bottom edges of the sides and ends are grooved and the bottom rabbetted and the sides driven into one end and the rabbetted end of the bottom inserted into the side grooves and driven home, and the other end put on and glued. The tanks are then finished up and are complete without the use of any metallic fastenings, such as nails, screws, etc.

The tanks are lined with lead in the lead-burning department. Sheet lead is cut to the proper size, inserted in the tank and the seams burned with a hydrogen flame.

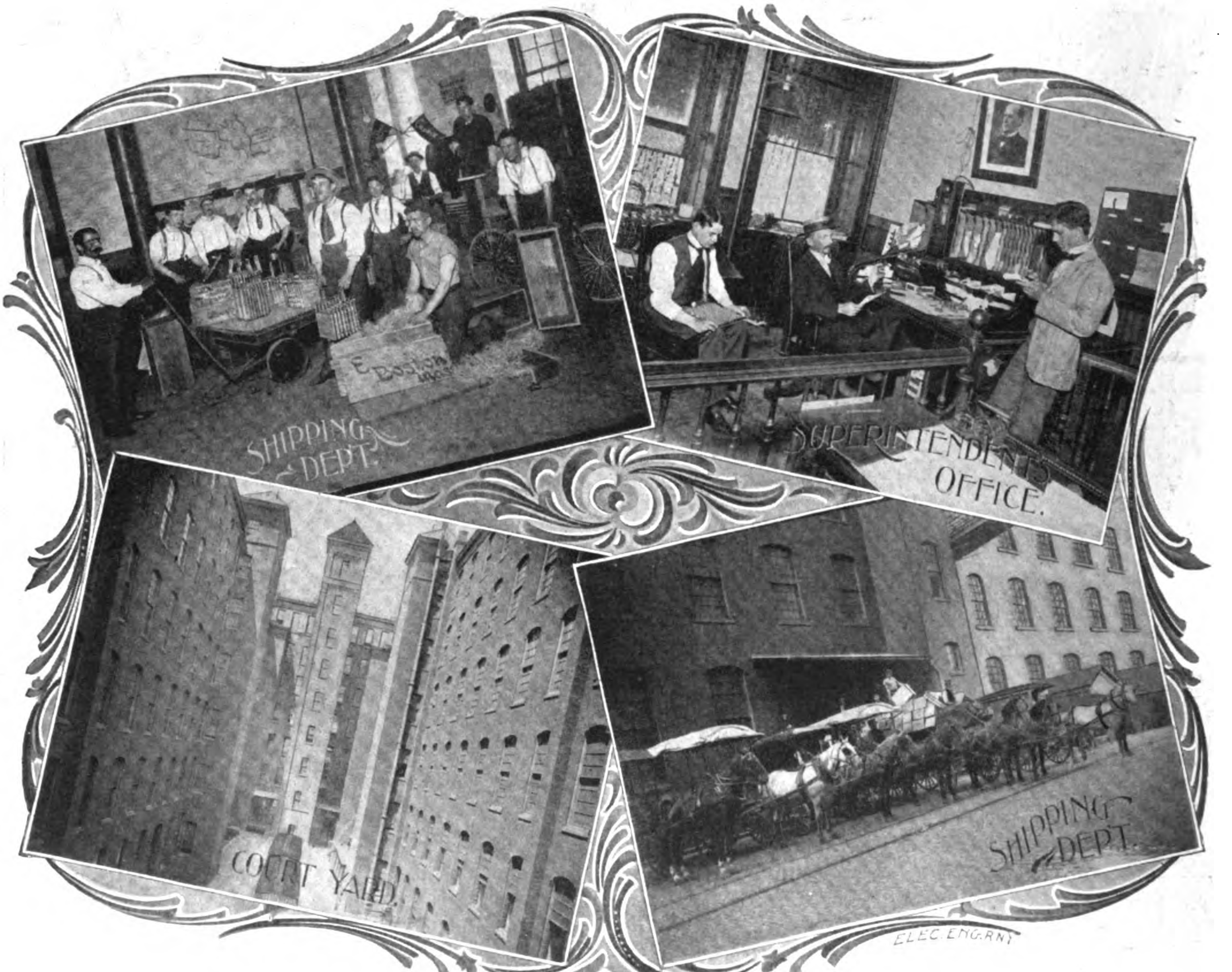
THE MACHINE SHOP.

It goes without saying that a well equipped machine shop is a sine qua non in an establishment of this kind. The machine shop is used for making all necessary repairs, but more especially for the copper work used in the construction of the various installations. All work of this nature is done according to drawings, and it is interesting to note that in a recent installation on the Pacific coast, not one hole in the thousands of pounds of copper shipped had to be even reamed, in order to make the proper fit. Of course, this is due to the efficient draughting corps, as well as to accurate machine work.

In the fitting department are made all the cups which are burned to the bus-bars to receive the copper, both for series and end cell connections; straps for the various sized cells, antimonious lead coverings for brass nuts, used in connecting the elements together; and the various other fittings.

THE LABORATORIES.

Where so much depends upon apparently small things as does the successful working of the storage battery it becomes necessary to investigate very fully and to subject to long and severe tests every detail and every material employed in and around the storage battery. It was to the lack of these tests that many of the early disasters of the storage battery are traceable.



Recognizing, therefore, the importance of testing everything, even to the last drop of water that goes into a storage battery, the company has organized and maintains in constant operation a series of laboratories. Thus, in the chemical laboratory all the lead, acids, water, electrolyte, etc., are analyzed. The company receives samples of electrolyte and water from all sections of the country in which they have batteries, which are analyzed free of charge.

The commercial laboratory is run in connection with the forming room, in order to keep the output up to standard. Sample plates from every batch are tested here, and the department is run night and day by a competent corps of experts.

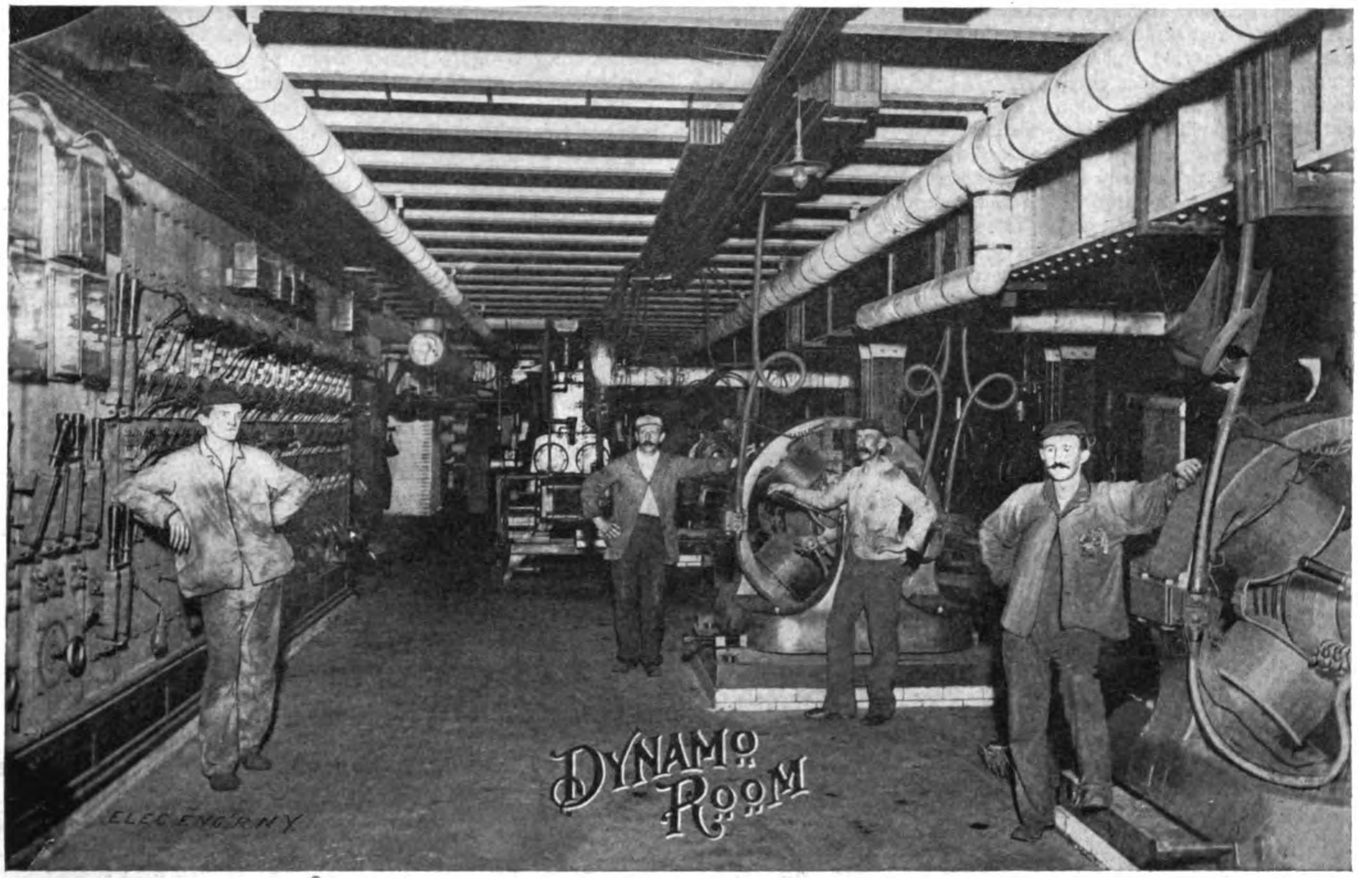
The experimental laboratory is used entirely for the purpose of research, and it is in this department that all the delicate tests are made, in order to determine the value of new types, course of treatment, etc.

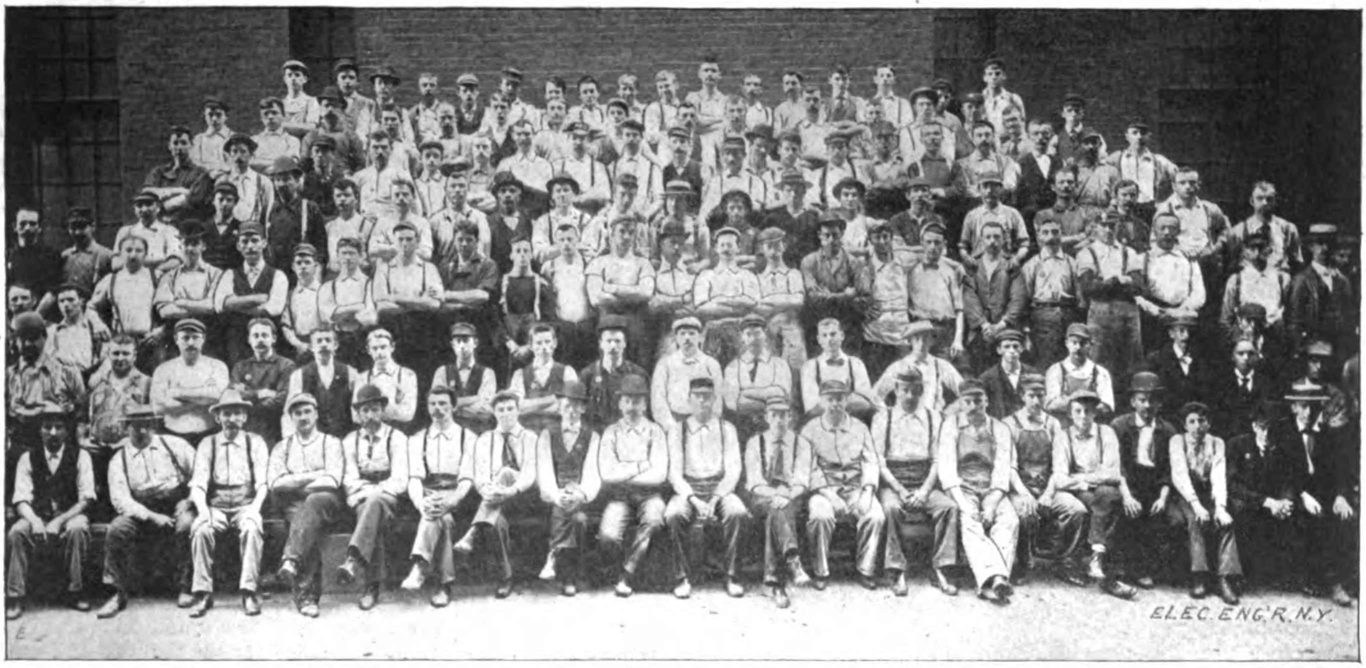
THE SHIPPING DEPARTMENT.

The shipping facilities of the works as noted above, are of the best, spurs running right to the doors from the Philadelphia & Reading Railway, as well as from the Pennsylvania Railroad. The construction of the plates is such as to allow of handling that would have been disastrous to former types. Thus a recent shipment of many tons of plates from Philadelphia to San Francisco arrived intact. The larger sized plates are packed in crates bolted together. These crates, when ready for shipment, weigh about six hundred pounds each, and when unpacked, the crates are returned to the factory to be used again for future shipments.

The mechanical power is derived from two 250 h. p. Westinghouse compound engines, which are clutched to the same shaft in the engine room, and this shaft is belted over a mule pulley to a vertical shaft running to the top of the building. From this shaft 25 horse power is delivered to each floor.

The three hundred, or more, employés have been with the company for the most part for several years and have become particularly well drilled in the class of work which they are called upon to perform.

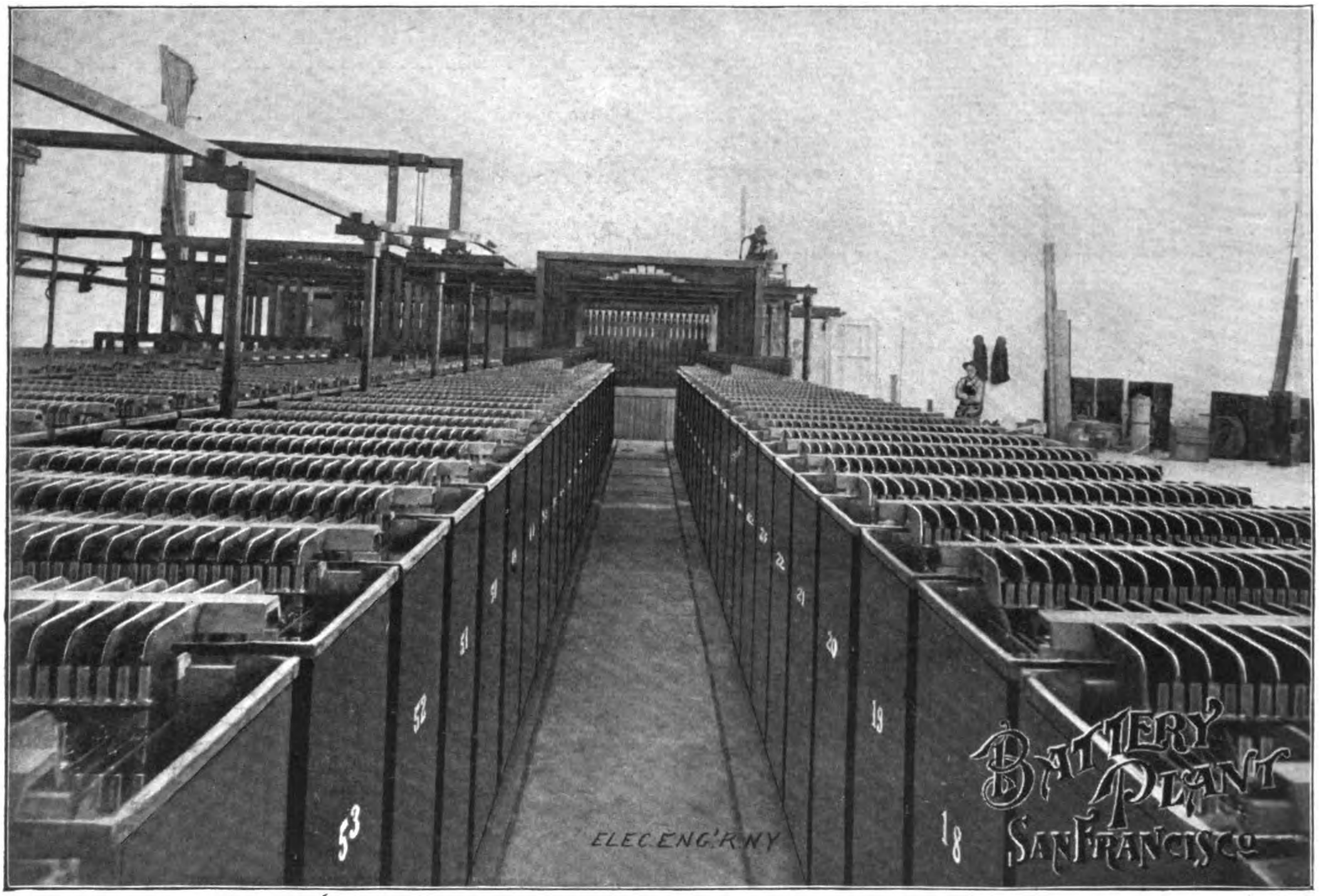




A PART OF THE FACTORY FORCE OF THE ELECTRIC STORAGE BATTERY CO.

THE COMPANY'S INSTALLATIONS.

From the description given above together with the illustrations depicting the various processes carried on in the factory, the reader will have obtained a very fair idea of the company's factory processes, and of its finished products. But equally interesting, if not indeed more so, must be an account of the installations carried out by the company in all parts of the country. A reference, even ever so brief, to all these plants would fill a good sized volume, and hence we will have to content ourselves with describing a number of typical installations, each illustrating one among a multitude of similar plants. These include practically every commercial use of the electric current, showing the application of the storage battery to lighting, railway working, telegraph, telephone, fire and police alarm, to domestic plants, and a variety of other purposes. These classes of work indeed are so numerous that even here we are confined to a selection, in order to keep within the limits of space available; but the installations which we are about to describe will afford a good idea of the scope and nature of the company's work.



A TYPICAL CENTRAL LIGHTING STATION BATTERY PLANT.

As the storage battery has thus far made greatest headway in electric lighting central stations we begin the descriptions of the various plants by an account of the most recent example carried out to completion, namely that at San Francisco, Cal.

The San Francisco Gas and Electric Company, who control practically all the lighting of San Francisco, installed late last year a large battery in connection with their Edison system. The total generating capacity of this portion of their plant is 16,600 amperes, divided up into units as follows: Five direct connected units, 400 kilowatt capacity each; one direct connected unit, 200 kilowatt capacity.

The capacity of this plant was reached in the winter of 1896, and in considering the question of increase, and after carefully weighing the advisability of more generating machinery, or batteries, they decided on the latter, and installed during the summer of 1897 a storage battery plant having a capacity of 1,750 amperes for three hours on each side of the system.

The engraving on this page shows the interior of the building erected especially as a battery house, with the battery in position. The structure is designed to house four such batteries, two on the ground floor and two on the first floor, the foundations and walls being specially constructed for the purpose.

There are one hundred and fifty cells, seventy-five on each side of the three-wire system, the containing tanks being 18 inches long by 46½ inches wide, by 39½ inches deep, inside measurement, all lined with four pound lead.

The connections between the cells are made in the usual manner by welding the plates to lead bus-bars. The regulating switches are erected in a little room partitioned off at one end of the battery room as shown, and these are operated by motors which are controlled from the main switchboard gallery, in the engine room; an electrical indicating device being provided which enables the operator to tell at any time the number of cells in use.

The diagram on page 451 shows the method of connecting and operating this battery in conjunction with the three-wire system.

The load curves shown on page 451 are taken from the San Francisco company's records after the battery was installed. It will be noticed from these that their demands for the winter of 1897 called for the full generating capacity of their station, in addition to which the battery took care of the peak, furnishing 5,000 amperes.

The operation of this battery has been very successful in reducing coal consumption, as it enabled the boilers to be kept on an economical load and prevented the necessity of getting up steam for a run of only an hour or two. The advantages accruing from this can be readily understood when it is remembered that coal costs about $5 per ton on the Pacific coast.

The battery is charged from the main bus through a pair of 50 kilowatt boosters direct connected to a single motor. This machine had been previously installed for the purpose of boosting the current from the main bus for the auxiliary, during the hours of light load, and it is found that in actual operation this machine is fully able to fulfill both functions.

This installation is the first of any magnitude on the Pacific coast and has excited great interest there among electrical engineers and suppliers of electrical power.

The recent development of the extensive water powers in California has made the question of storage of electricity an important one, as in nearly every case these water powers are leased subject to "irrigation rights," which prevents the companies operating these water powers from "damming back" the water when not required. This means that they can only avail themselves of a portion of the total power unless they store the surplus in the form of electrical energy in storage batteries.

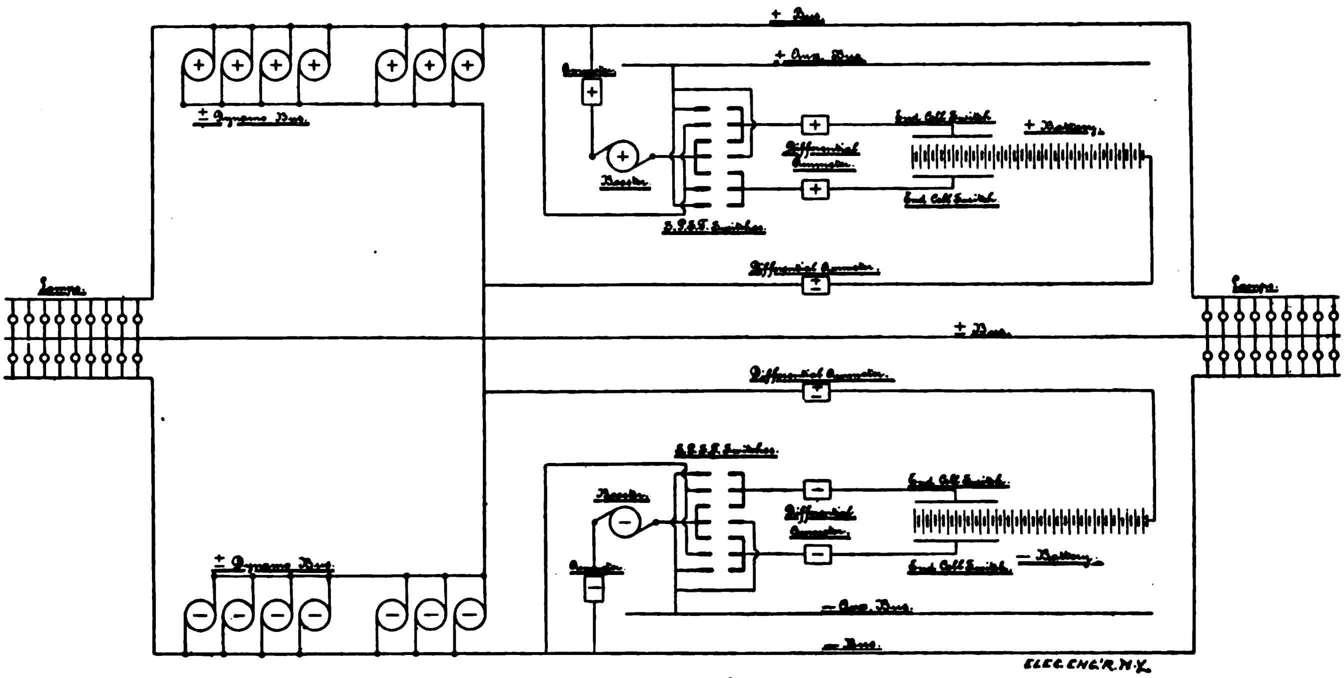
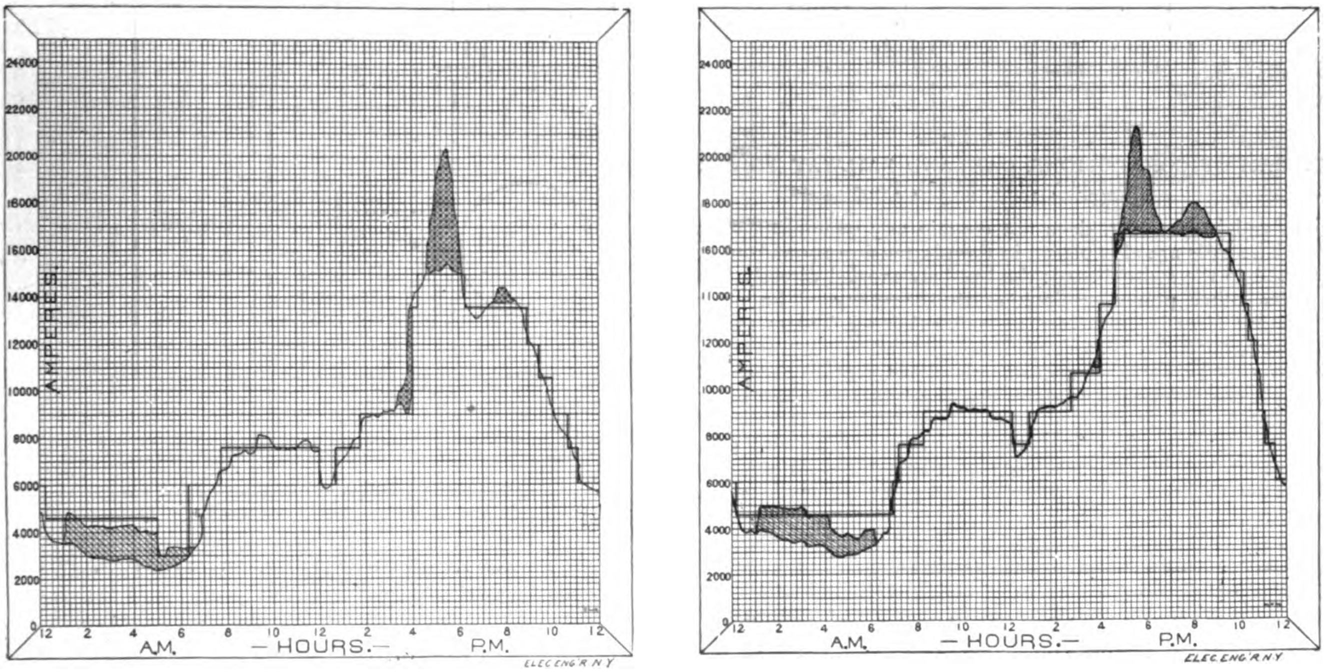


DIAGRAM OF CONNECTIONS, STORAGE BATTERY PLANT, SAN FRANCISCO GAS AND ELECTRIC CO.

THE STORAGE BATTERY IN RAILWAY WORK.

Until quite recently the work of the storage battery in the United States had been confined principally, to electric lighting, with, of course, numerous minor though not less important applications. But after ten years of electric railroad work it suddenly dawned on street railway managers that the conditions under which they were operating were such as to render the use of a storage battery of the very greatest economical importance. Although, as just stated, this recognition has come somewhat late it is being acted upon with all the more alacrity. Already a number of railways have been equipped in this manner, and we propose to describe briefly the latest installation of this kind.

Upon the organization of the Consolidated Traction Company from the several lines in Pittsburg which form that corporation, the new company faced the problem of the proper rearrangement of the power generation for the most economical operation of the road from its seven power houses, three of which were electric and four cable, and all of which had been built for the needs of the several independent lines. One of the results of the solution of this problem was the adoption of storage batteries as station auxiliaries.



LOAD DIAGRAM OF SAN FRANCISCO GAS AND ELECTRIC CO., AFTER INSTALLATION OF STORAGE BATTERIES.
The Single Cross Hatched Portion Indicates Battery Charge. The Double Cross Hatched Portion at the Peaks Indicates Battery Discharge.

During June, 1897, the Electric Storage Battery Company installed for the Consolidated Traction Co. two plants, located at the Oakland Station, on the corner of Fifth avenue and Atwood street, and at Thirty-fourth street and Penn avenue. The

former of these plants consists of 260 cells, and the latter of 248 cells, each capable of discharging at the rate of 500 amperes in regulating the rapid fluctuations of load, the difference in the number of cells being due to the difference in voltage at the two points.

The engraving on page 453 shows the plant installed at Oakland Station. The latter is an old cable station, the batteries occupying the space formerly devoted to the tension room. The old cable engines are still in use, two in number, each driving one end of a shaft, the main driving drum on this shaft having been replaced by an 800 kilowatt generator, which is thus directly driven.

The battery is connected in parallel across the bus-bars, as would be the case with another generator, and is controlled directly on the switchboard by a separate generator panel, with circuit breaker, ammeter, voltmeter, and quick break switch. The ammeter is not of the ordinary type, but differential reading, with zero point in the centre of the dial; it gives the flow of current in each direction, and during most of the day the indicator oscillates from one side of the scale to the other with the variation of the external circuit. See diagram, below.

The battery at Thirty-fourth street also occupies an old cable

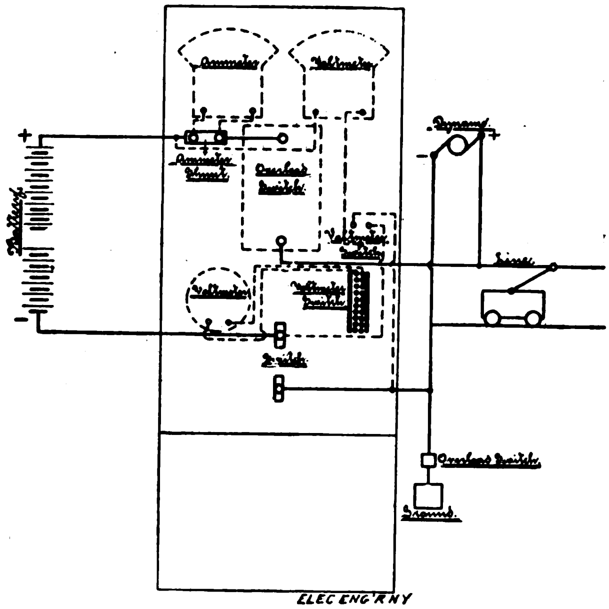


DIAGRAM OF CONNECTIONS, OAKLAND RAILWAY POWER HOUSE, PITTSBURG, PA.

station, which, however, does not contain any generating apparatus. The cells are also placed in the old tension room, and are connected to the switchboard; the bus-bars are fed directly from the three other power stations of the company. The power stations are directly connected to each other by feeders as well as by the parallel circuit, a condition which while not impossible were no storage batteries in use, would yet require some care to prevent the reversal of some of the generators at a low potential station and their operation as motors by the generators at the other stations. The batteries act as reservoirs and regulators somewhat in the same way as stand pipes in pumping stations act to keep the pressure on the pumping engines constant.

The flexibility in the manipulation of power stations secured by the use of storage batteries is remarkable. The engineers can adjust the load between the different power stations as desired by changing the voltage. Thus, if any one station were carrying less load in proportion to its capacity than the other stations, the engineers at that station would cut out some field resistance, raising the voltage at that station and throwing it on more of the mutual load by relieving the other stations. This renders possible the shutting down of part of the equipment of a station for repairs during a heavy demand for current by making the other stations carry part of the load in the station in which the repairs are being made.

It has been found that the capacities of the stations have been greatly increased in excess of the added output of the batteries, so that while in the consolidation of the different systems three cable plants were abandoned, no additional generating apparatus has been installed, although the number of cars operated has been largely increased. This is attributed by the managers to the elimination in the loads of the momentary peaks which really set a limit to the output of the generators. Thus, in the Consolidated Traction Company's system, in Pittsburg, a station containing an 800 kilowatt generator in connection with a 500 ampere hour battery has given an average output of 2,000

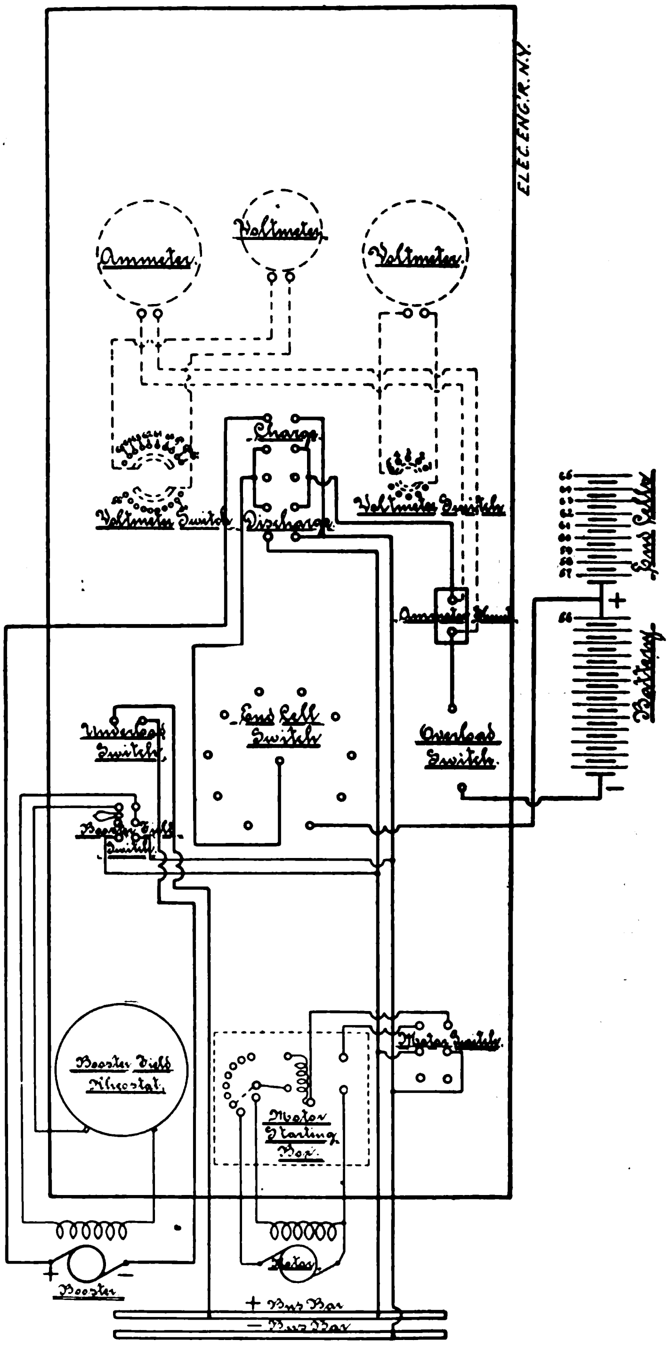


DIAGRAM OF SWITCHBOARD CONNECTIONS, STORAGE BATTERY PLANT IN READING TERMINAL STATION, PHILADELPHIA.

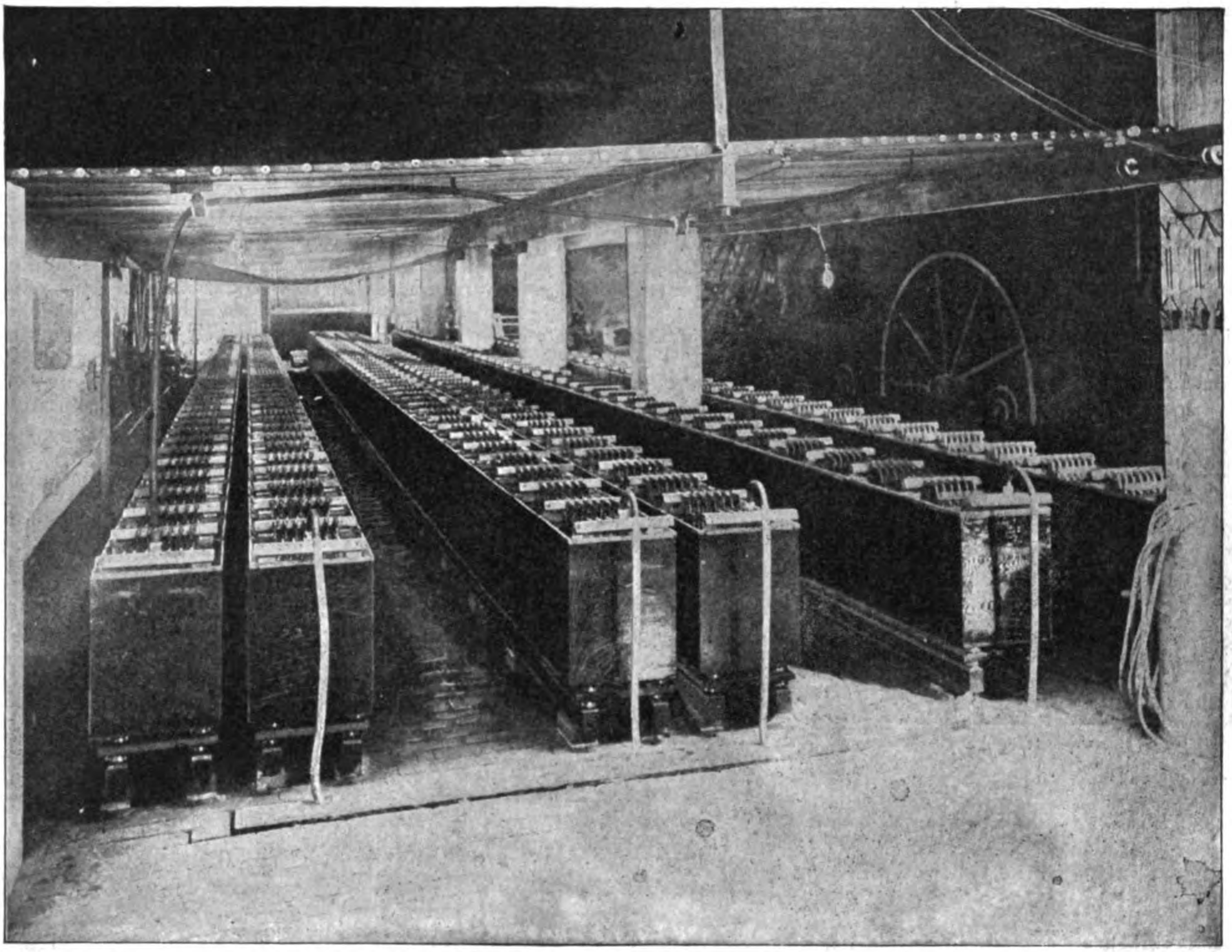
amperes continuously at about 525 volts for twenty-four hours without destructive effect.

A TYPICAL RAILROAD STATION BATTERY PLANT.

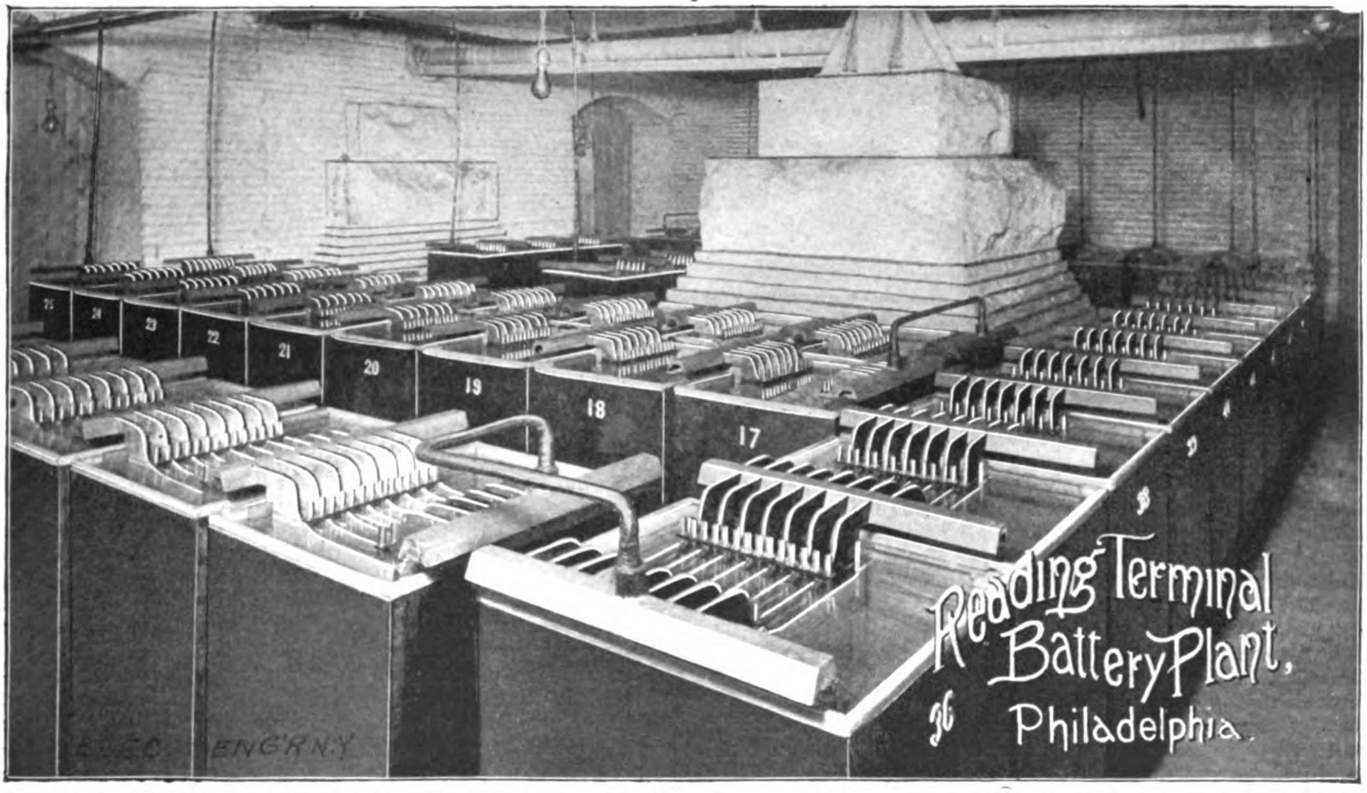
A notable plant recently installed in Philadelphia by the Electric Storage Battery Company, is that at the great Reading Terminal, the home station of the Philadelphia & Reading Railway Company, and shown on the page opposite.

The battery is an adjunct to the lighting plant which not only supplies the waiting rooms, ticket offices and train shed, but also the ten story office building and large market houses that are included in the one structure. This lighting plant consists of

two alternating units and three direct current units besides a number of arc light machines and the battery. The last contains



STORAGE BATTERY PLANT, OAKLAND POWER HOUSE, CONSOLIDATED TRACTION CO., PITTSBURG, PA.



65 cells of Chloride accumulator 15-G type, of 980 ampere hours capacity, capable of discharging at a maximum of 560 amperes.

The plates are contained in lead-lined wooden tanks large enough to allow of an increase in the capacity of the battery to 1,400 ampere hours by the simple addition of a proportionate number of plates which can be inserted and burned in at any

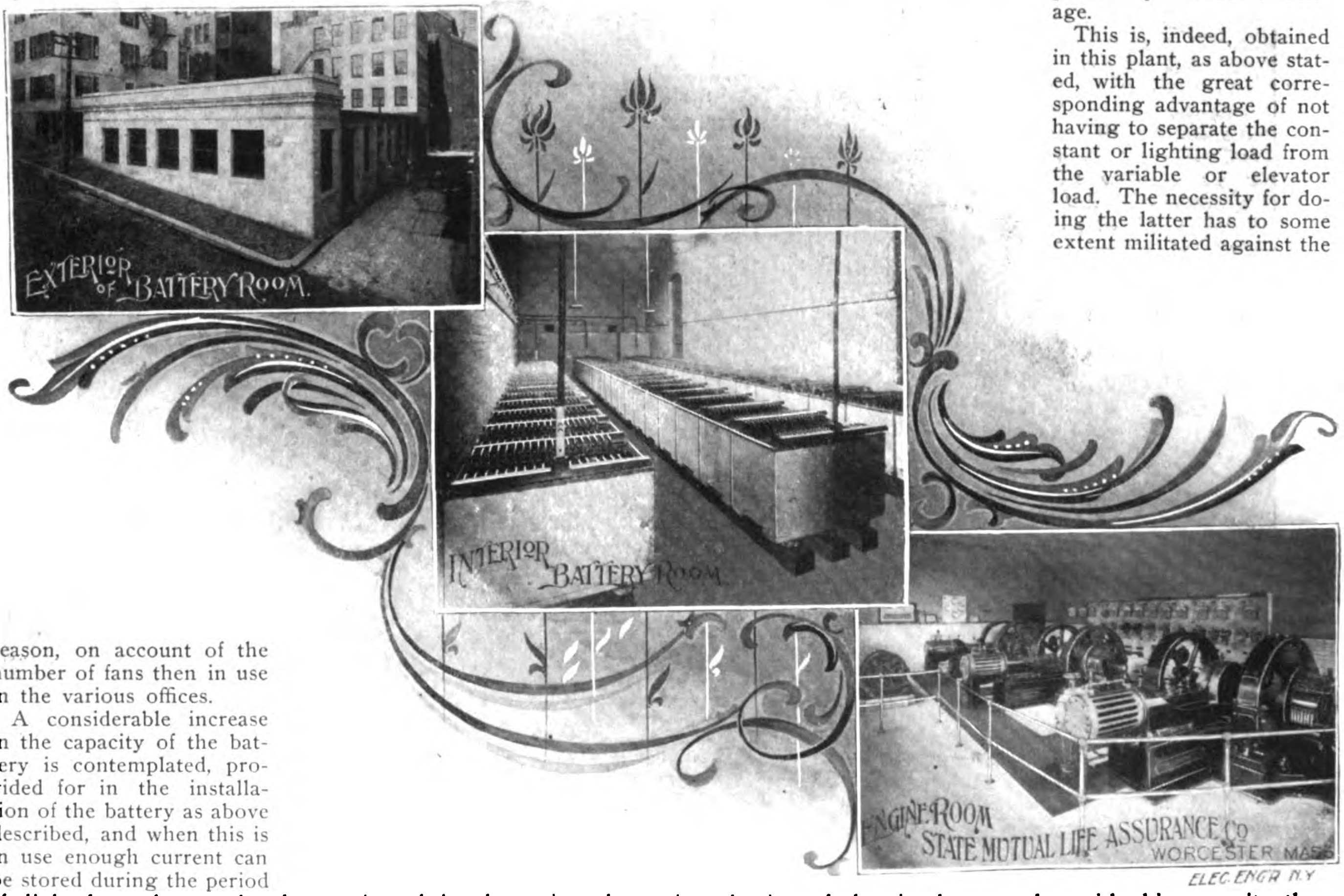
time. In this connection it may be mentioned that in accordance with the best modern practice the plates in this plant are burned into place to heavy lead bars between each tank, and the cable leads are burned into lead cups in the bars, thus entirely eliminating all bolts or clamps and making lead the only exposed metal throughout.

The switchboard is the standard panel of the Electric Storage Battery Company when a motor driven booster is used and the connections are shown in the diagram on page 452.

The function of the battery in this plant is to aid in carrying the peak of the load which accrues during the evening of each day and to carry alone the entire load for several hours each night. Besides this, a by no means unimportant service fulfilled by the accumulator is to take care of any sudden demand that may come upon the circuit. For this purpose it is kept constantly across the bars and has more than once prevented an interruption of the service.

As a result of the ability of this battery to take care of the peak of the load the alternating machines are shut down entirely during the summer, a great convenience, if for no other reason, on account of the number of fans then in use in the various offices.

A considerable increase in the capacity of the battery is contemplated, provided for in the installation of the battery as above described, and when this is in use enough current can be stored during the period of slight demand to render the running of the alternating plant entirely unnecessary, making through the saving in labor, etc., a very substantial return on the battery investment.



AN OFFICE BUILDING PLANT.

An exceedingly novel and interesting application of the storage battery as an adjunct to an electric plant is exemplified in the installation of the State Mutual Life Assurance Company's building. The plant supplies electric light and power for offices and elevators in the splendid home of the company at Worcester. Mass. It is housed in a well designed separate one-story building permissible by the low price of real estate, and this allowed a more than usually generous treatment as to the space allotted to the apparatus.

The generating plant consists of three direct coupled units. There is also in connection with the battery a specially wound motor-driven 16 kilowatt booster generator built for the Battery Company by the General Electric Company. The boiler plant which furnishes steam for heating the building in addition to that required by the engines, consists of Babcock & Wilcox water tube boilers. Three views of the plant are shown on this page.

Besides its usual duties as a reservoir for carrying the night load and aiding with the peak, the storage battery has here its capabilities as a regulator brought to practical perfection. This is rendered specially necessary because of the electric elevators in the building. There are four of these, of the Sprague screw type. By the use of the battery it is possible to supply current for these from the same generator that supplies the lamps, without in any way affecting the steadiness of pressure on the latter. This result is obtained by combining with the battery the special booster above referred to. This booster is so connected as to aid the inherent tendency in the battery to respond to sudden demands on the circuit to which it is connected, and to prevent these fluctuations from coming upon the generators. This it does to perfection in this case and there is not at any time a greater variation than one per cent. on the lighting bus even with the greatest elevator load. The battery ceases to charge, and discharges in aid of the generators, whenever an elevator starts and the adjustment can be made so that the variation in current on the generators will not exceed a given amount. Of course with compound generators this means a practically constant voltage.

This is, indeed, obtained in this plant, as above stated, with the great corresponding advantage of not having to separate the constant or lighting load from the variable or elevator load. The necessity for doing the latter has to some extent militated against the introduction of electric elevators, but with this necessity thus effectually removed the very great advantage of not having to add any hydraulic machinery to an office building electric plant will do much to strengthen the position of the electric type.

A RESIDENCE LIGHTING PLANT.

The desire to have the benefits of the electric light extended to country residences as well as to their town houses has led many to install isolated plants on their country places. Among these is Mr. Frank Thomson, president of the Pennsylvania Railroad. At his widely known country seat, Corker Hill, this gentleman has, in conjunction therewith, what may be called a model isolated lighting plant. From this the house, stable, grounds, etc., are lighted by electricity absolutely independently of any outside source.

The building, which is shown in the group on page 455, contains the lighting plant; it is of rough gray stone about 17 feet wide by 60 in length, having a peaked roof of blue slate, the whole making an exceedingly picturesque feature of the landscape. The house is thoroughly fireproof and is well and substantially built though without any undue expense. It is provided with a cement concrete floor and is divided into three in-

terior rooms by partitions of plastered wire lathing. These rooms, views of which are given, are engine room and battery room; the switchboard is also shown.

The engine is a 26 horse power special electric light, Otto gasoline engine. The gasoline for the engine is pumped directly from the barrels into a tank sunk in the ground outside the building, thus removing all danger of explosion.

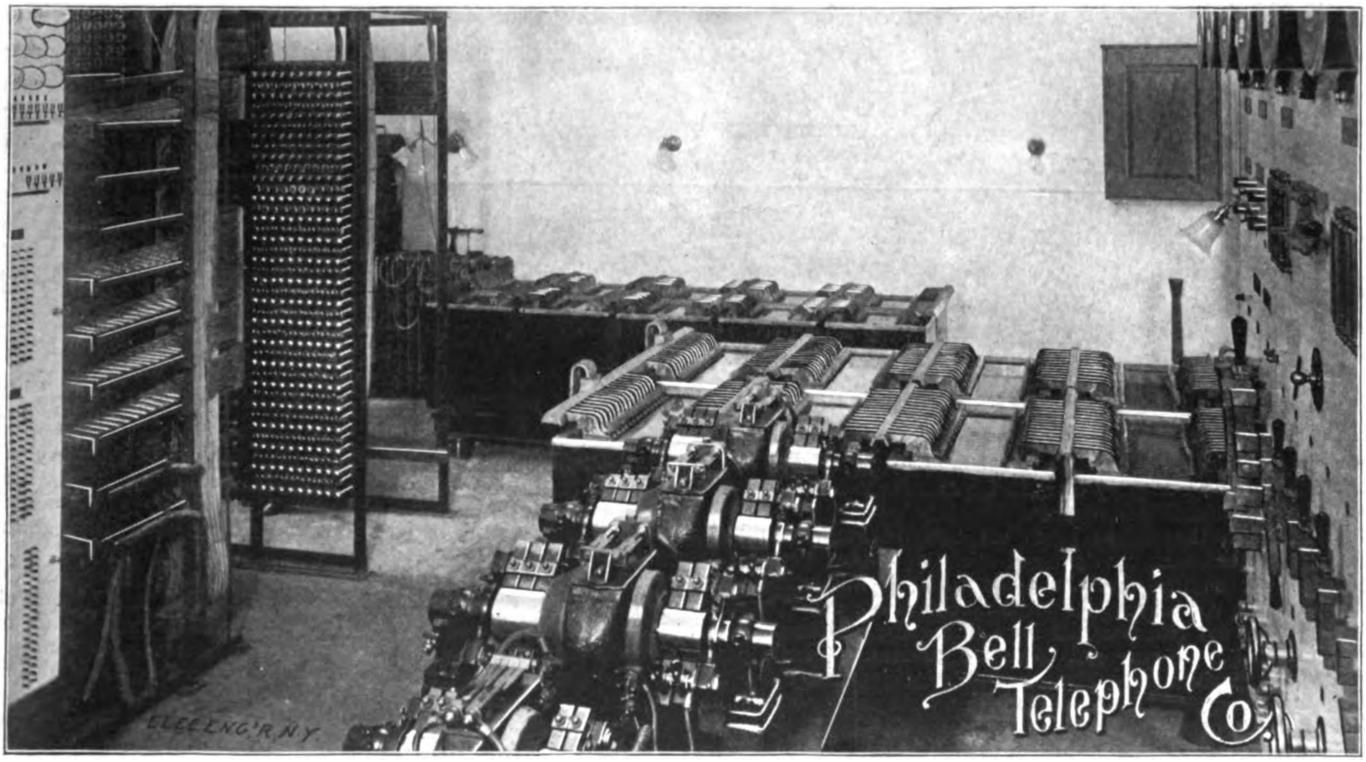
The dynamo is a 20 kilowatt Electro Dynamic Company's, 150-volt shunt wound generator, belted to the engine and provided with a heavy fly wheel pulley thus aiding the engine in maintaining a constant speed. The switchboard is of white Italian marble set in a polished oak frame in the partition between the engine room and the engineer's private room. From this board are controlled the following operations: Lighting direct from dynamo with or without battery in parallel. Charging battery, providing light at same time, or not, as desired. Discharging battery on lights alone.

The battery consists of 62 cells of Chloride accumulator 11-G type contained in lead-lined ash tanks arranged in two tiers on wooden stands so disposed around the battery room as to permit easy access to any cell.

The principal functions of the battery in this plant are to insure absolute steadiness in the light furnished by compensating for unavoidable variations in speed of the engine and dynamo, and to render the light available at any hour of the twenty-four without requiring the engine to be run except at the most convenient times.

The current from the plant is carried a distance of three hun-

VIEWS OF STORAGE BATTERY LIGHTING PLANT AT MR. FRANK THOMSON'S COUNTRY SEAT, CORKER HILL, PENN.



dred yards on a line that is carried partly underground and partly on poles to a distributing board in the basement of the house. From this board are controlled the various circuits of the quite extensive system such as that for the stable, billiard room, etc.

The battery is usually charged at night by the night watchman. As the operation of the apparatus is largely automatic this does not interfere in any way with his other duties, and at the same time the expense of a special attendant is rendered unnecessary.

THE STORAGE BATTERY IN TELEPHONE EXCHANGES.

Modern telephone practice has made a great advance by centralizing the batteries needed by the subscribers in talking. This practice not only results in direct saving of cost of battery power, but also materially improves the efficiency of the service by having the batteries together and in a place where they are under constant supervision of experienced men. The storage battery also furnishes all current for automatic signaling.

The most up-to-date telephone installation of this kind is that recently put in operation in the splendid new exchange of the Bell Telephone Company of Philadelphia, situated at the corner of Eleventh and Filbert streets.

Situated in the engine room are two machines, forming a duplicate plant, each consisting of one New York Safety Steam-Power Co. engine, direct coupled to a 30 kilowatt General Electric 110 volt dynamo. These machines are run alternately every other day and are used for lighting the building and furnishing power at 110 volts to motor generators in the power room on the sixth floor, illustrated on page 455, used for charging the storage batteries and furnishing ringing power to the telephone switchboard.

The motor generators furnished by the Crocker-Wheeler Company, have their primary ends connected to the 110 volt direct current circuit fed from the generators in the basement. These motor generators comprise two 1,500 watt machines for charging a 20 volt battery; one 1,500 watt machine charging an 8 volt battery; one 500 watt machine charging a 4 volt battery; and two ¼ h. p. 75 volt alternating current motor generators for ringing.

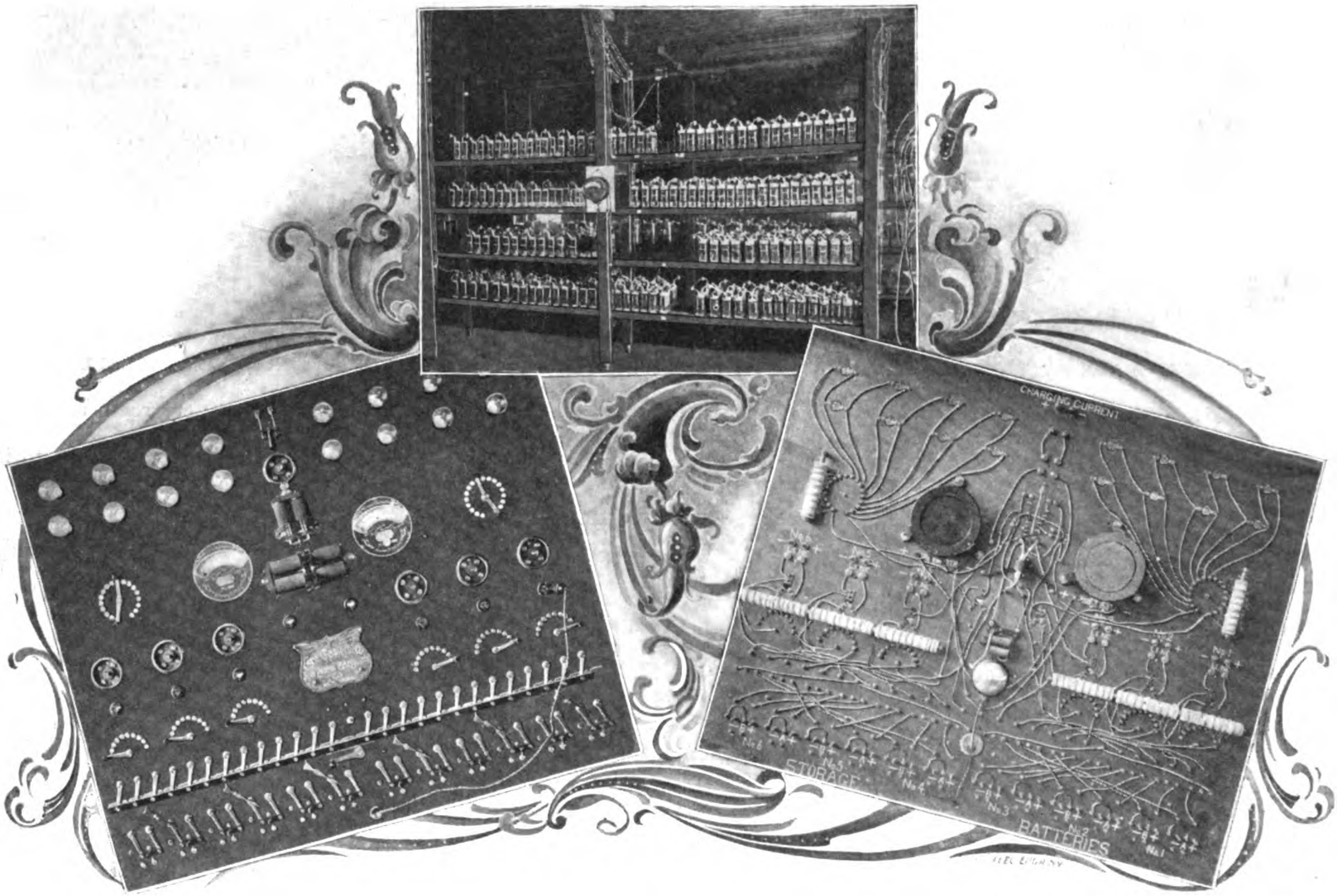
Only one machine is furnished for the 8 volt and the 4 volt batteries which are in duplicate. To avoid a possible breakdown, a Carpenter enameled rheostat is furnished so that the batteries of lower voltage can be charged from batteries or motor generators of higher voltage. All machines are protected with automatic safety cut-outs.

The 20 volt battery consists of ten No. 13 G type Chloride accumulators, which furnish all the current needed by the subscribers for talking and for calling up the office.

The 8 volt battery, in duplicate, each consists of four No. 31 cells. This battery furnishes current for the "disconnect" signals on the operators' cords and for the relays which cut out the subscriber's lamp signal when the operator answers his call by plugging into the jack corresponding to the lamp signal.

The disconnect lamps are so wired that they burn only when the subscribers connected by the cord need attention from the operator. They do not light while the subscribers are talking.

Half the drop in potential of the 8 volt battery is in the 4 volt lamp, and the other half in the cut-out relay. This battery is in duplicate, so that one can be charged while the other is being discharged. This avoids danger of burning out the lamps, as the voltage of the battery is raised from 8 to 10 volts during charging.



MUNICIPAL FIRE ALARM AND POLICE TELEGRAPH STORAGE BATTERY PLANT, WILMINGTON, DEL.

The 4 volt battery consists of six 13 F cells, in duplicate. One of these sets consists of four cells, two in series, two in multiple; the other of two cells. The two extra cells are needed on one of the batteries to supply current for the operators' transmitters. This battery is arranged to furnish a current of 4 volts or 2 volts, as desired. The 4 volt battery also furnishes all current for lighting the lamp signals which light when a subscriber takes his telephone off the hook. This lamp is put out when the operator answers the call, as was described under the 8 volt battery. This battery is made in duplicate, one being charged while the other is discharged, to avoid burning out the lamp from the higher voltage during charge.

The power switchboard and mounting fuse board are con-

structed of white marble, mounted on an iron frame, and equipped with switches, measuring instruments, fuses, etc., for the necessary circuits.

The function of the battery is as follows: The subscriber, by taking his telephone off the hook, operates a relay at the central office, which operates a 4 volt lamp in front of the operator at the switchboard; this lamp is extinguished as soon as the operator plugs into the jack. The cord with which the operator connects together the jack of the subscriber calling with that of the

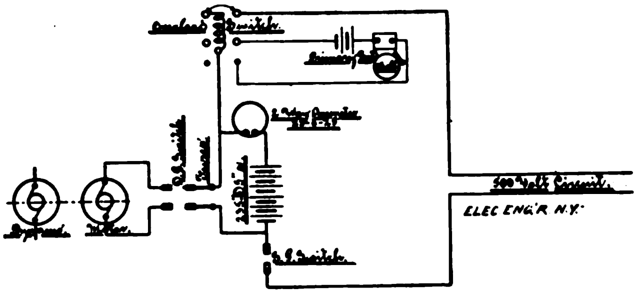


DIAGRAM OF CONNECTIONS OF STORAGE BATTERY, POSTAL TELEGRAPH CABLE CO., ATLANTA, GA.

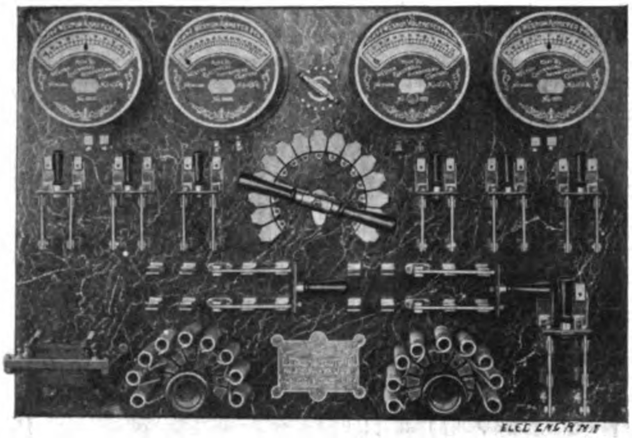
subscriber desired is wired to the 20 volt battery, which furnishes all the current used by the subscriber in talking. The automatic 4-volt lamp "disconnect" signals on the operators' cords are operated in the manner already described.

This storage battery installation has turned out even beyond the expectations, and when one considers that it replaces thousands of cells scattered over a wide area among subscribers, its convenience as well as its economy and reliability will be appreciated by others besides telephonists. It is, indeed, only a question of time when all telephone exchanges will have their electrical energy concentrated at the central office under the constant supervision of the technical staff.

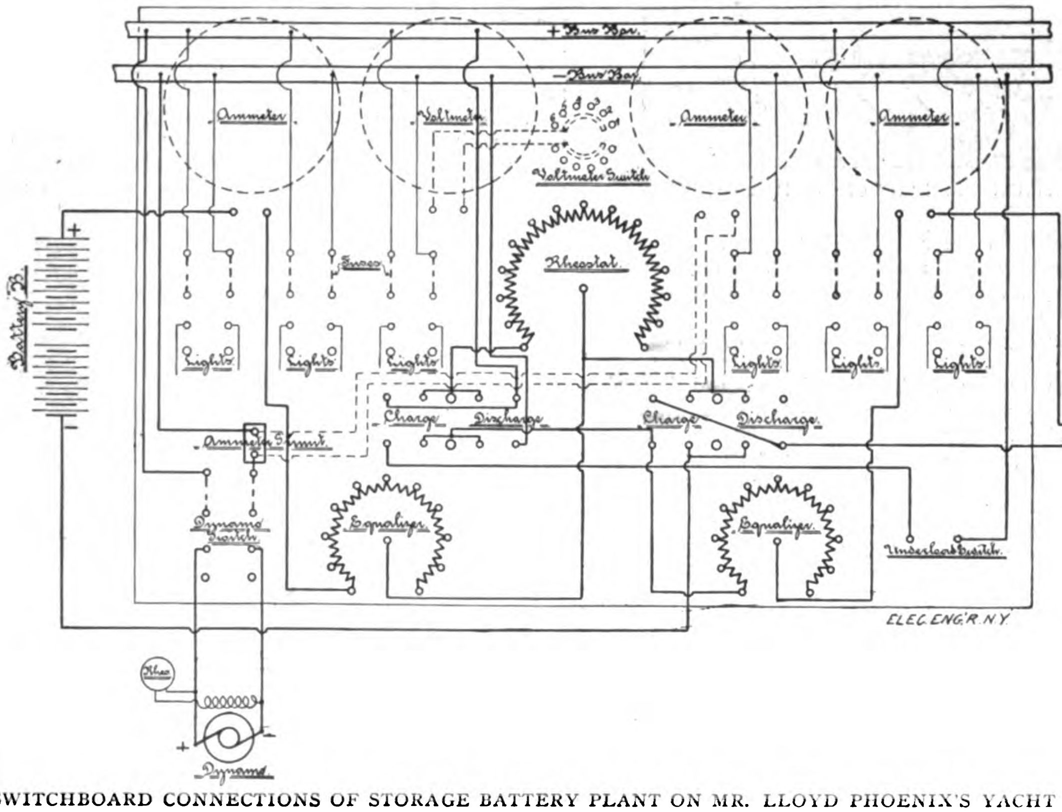
THE STORAGE BATTERY IN A TELEGRAPH OFFICE.

An interesting application of storage batteries to telephone and telegraph work is their use as a regulator to the source of current, when for any reason the latter is of variable potential.

As an example, the installation at the Postal Telegraph-Cable Company's station at Augusta, Ga., may be cited. In this case the source of current is a trolley circuit. From this circuit current is taken through motor generators for the lines. In order to avoid the bad effects of the variable potential on the railway circuit a battery of Chloride accumulators is connected across the terminals of the motors. This battery alternately charges and discharges with the variable potential on the railway circuit and prevents the fluctuations from exceeding an allowable limit. Owing to the low internal resistance of the storage battery it is impossible that a variation in voltage beyond a certain limit can occur at its terminals with a change in current. The diagram on this page shows the battery and dynamo connections.



SWITCHBOARD OF STORAGE BATTERY PLANT ON YACHT "INTREPID."



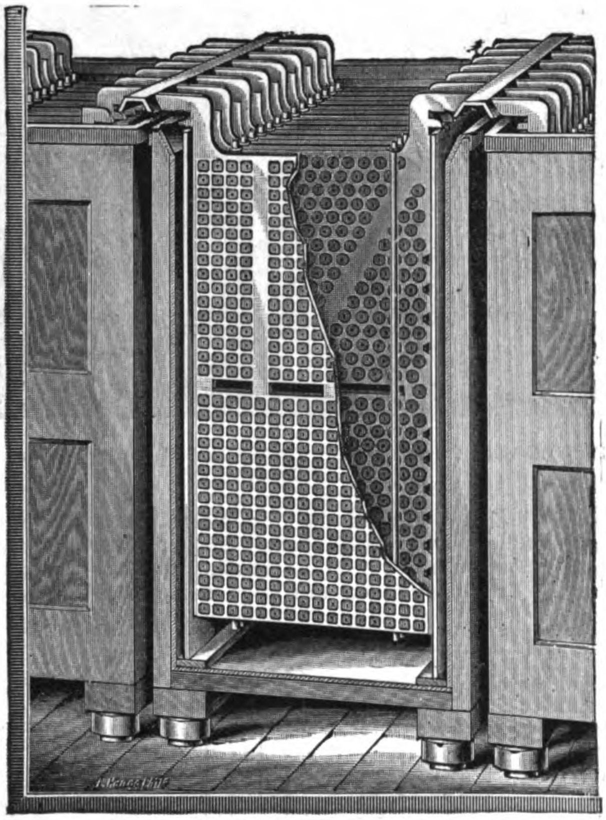
SWITCHBOARD CONNECTIONS OF STORAGE BATTERY PLANT ON MR. LLOYD PHOENIX'S YACHT "INTREPID."

THE STORAGE BATTERY IN FIRE ALARM AND POLICE TELEGRAPH WORK.

An important application of storage batteries that is in itself a specialty is that to municipal fire alarm and police telegraph systems. As an example of a first-class installation of this sort we may refer to that in the city of Wilmington, Del., which was installed under the supervision of Mr. John L. Hall. The battery here consists of 470 cells divided into eleven circuits fed by from 7 to 30 cells each, a duplicate set being provided for each circuit. These cells replace the same number of gravity cells.

The views on page 456 show one tier of the battery and illustrate the method of installation; also a front view of the switchboard and the back of a six-circuit board.

The current from the street mains enters at the double pole knife switch at the top of the board; thence after passing through a fuse and two automatic circuit breakers it is distributed to the charging circuits.



CENTRAL STATION TYPE "H" CHLORIDE CELL.

The discharging circuits enter at the bottom of the board through fuses, spring jacks and resistance coils. The jacks are of a special three-way form and allow of the simultaneous insertion of voltmeter and ammeter into the circuits. The resistance coils are employed to compensate for any change in the line resistance.

The battery circuits enter at the bottom of the board through transfer switches which enable them to be connected with the board, or not, as desired. From these battery switches the circuit goes to the main gang switches which transfer simultaneously all the circuit from one battery to the other of that set. All these operations as is essential in this class of work are performed without at any time opening the circuit.

Among the advantages of secondary batteries for this work may be mentioned their cleanliness, steadiness of potential, saving of floor space, small amount of attention required and, above all, their economy. At the Wilmington plant, it is estimated that there will be a saving of $1,200 per year over the cost of the old gravity cells.

A YACHT LIGHTING PLANT.

A typical installation of this type is that on the yacht "Intrepid," owned by Mr. Lloyd Phoenix.

The storage battery forms a practically indispensable adjunct to this plant. The elements are contained in rubber jars known as the "yacht type" because of the extra height desirable for this use. These jars are contained in lead-lined wooden trays built into the boat, of such shape and size as to best utilize the space available.

The switchboard controlling the operation of the plant is a marbelized slate panel 3 by 4 feet in size mounted in the engine room near the dynamo. This board contains all the necessary apparatus to perform the various operations of charging, discharging and lighting direct from the dynamo. See page 457.

The instruments are Weston round pattern. Regulation of charge and discharge is effected by a rheostat in the battery circuit. For the charge, the battery is divided into two sets which are put in parallel. The whole battery is in one series on the discharge. This is the usual practice in yacht installations in order to avoid the complication of end or counter cell regulation, and to avoid at the same time the use of a booster, or raising the dynamo voltage above that of the lights. The connections of the switchboard are shown on page 457.

The battery has a capacity of two hundred and fifty (250) ampere hours.

The installations we have described have been taken from among scores and scores carried out by the Electric Storage Battery Co., and the space at our disposal does not suffice to permit us to more than hint at other typical fields of the company's activity. Thus we might have gone into the now most promising storage-battery car work being carried out, an excellent example of which is the Englewood & Chicago Railway, on which road 30 storage battery cars have been running for over a year most successfully under all conditions of service met with in actual practice.

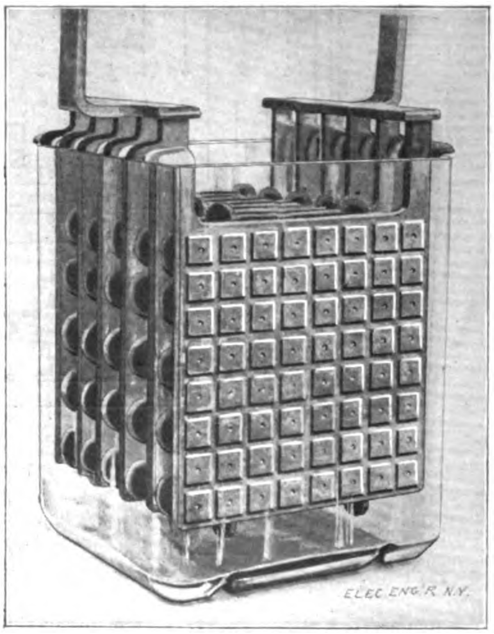
Then there is that fascinating means of marine propulsion, the electric launch, of which hundreds are now in operation all over the country; not to speak of those sent abroad and equipped in every detail on this side of the water.

And then there are the electric carriages now rapidly coming to the front, one hundred being in course of construction, to be added to the electric cabs now operating in New York.

To this already long list we might add the mention of the use of the storage battery in train lighting now being carried on extensively on the cars of the Atchison, Topeka & Santa Fé Railroad. And last, but not least, we may recall the use of the portable batteries for driving phonographs, kinetoscopes, automaton pianos—in fact, an endless number of miscellaneous applications requiring small power in handy form.

The engravings on this page give some idea of the general type of the Chloride cells in use. These range in weight from the 8-pound portable cell to the 6,000-pound cell, as installed in some of our large electric lighting and railroad power stations.

In drawing this narrative to a close the writer calls vividly to mind a visit paid to the same establishment about seven years ago. The difference in the factory activity at that time as compared with its present hum of business everywhere can be best conveyed to the reader by the statement that while at the period mentioned, about fifty men sufficed to carry on all the work



ISOLATED PLANT TYPE CHLORIDE CELL.

with ease, no less than three hundred men, aided by the most improved automatic machinery since developed, are hard pushed to keep up with the company's rapidly increasing business. That tells the story of the growth of the storage battery in America better than any statistics can do. At the present rate of increase, indeed, the figures of to-day may well be doubled within the twelve-month now passing.

THE COMPANY'S MANAGEMENT.

The personnel of the management of a concern whose product occupies such an important place in electrical work must always be of interest, being an index of its character and a guarantee of its stability.

Mr. Isaac L. Rice, the president, is a gentleman well known in financial and electrical circles. Mr. W. W. Gibbs, the first vice-president, scarcely requires an introduction to our readers; his early faith in the storage battery and his successful efforts in bringing under one control the principal patents relating to the storage battery art will be fresh in the minds of all.

OFFICERS AND STAFF OF THE ELECTRIC STORAGE BATTERY CO.

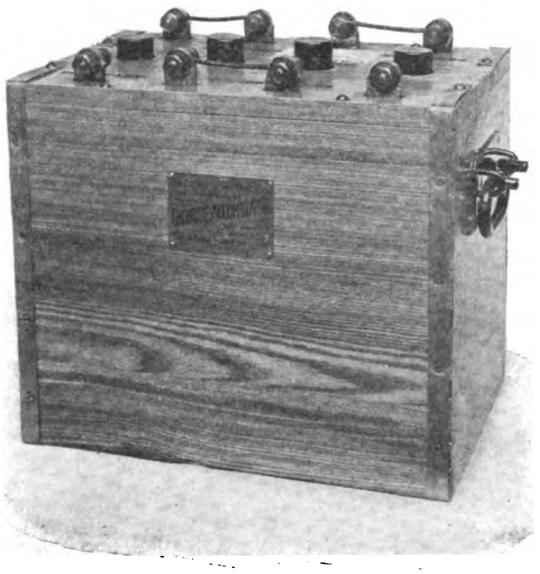
1. Isaac L. Rice.
2. W. W. Gibbs.
3. Herbert Lloyd.
4. Benjamin W. Tingley.
5. Joseph Appleton.
6. R. McA. Lloyd.
7. J. B. Entz.
8. John R. Williams.
9. C. W. Woodward.
10. J. B. Falkner, Jr.
11. Charles Blizard.
12. F. J. Stone.
13. W. O. Knudsen.
14. R. C. Hull.
15. F. H. Clark.

Mr. Herbert Lloyd, second vice-president and general manager

of the company, almost from the organization of the company in 1888, has had entire charge of the commercial as well as the technical development of the company's business. To Mr. Lloyd's abilities as a chemist and engineer, added to a high order of business ability—a rare combination—is due in no small degree the success of the company's business.

Mr. Benjamin W. Tingley has long served as secretary and treasurer of the company with great credit.

The company's Board of Directors is composed of the following gentlemen, most of whom are well known in the world of finance and industry: W. W. Gibbs, C. A. Griscom, Gustav E. Kissel, Joseph F. Sinnott, Edward Tuck, Edward C. Lee, John I. Waterbury, George Philler, W. D. Winsor, Herbert Lloyd, Rudolph Ellis, Grant B. Schley, Randal Morgan, Isaac L. Rice, Philip Lehman.



LARGE PORTABLE CHLORIDE ACCUMULATOR.

The principal offices of the company are in the Drexel Building, Philadelphia. For promoting the sale of its batteries, the country is divided into districts with a branch office in each district, the location of the various offices being as follows: New York, Boston, Chicago, Baltimore and Cleveland, and an agency on the Pacific Coast. The managers of the branch offices, in addition to their clerical force have the assistance of an engineer as well as a competent staff of experts who work under the direction of the main office.

SMALL PORTABLE ACCUMULATOR.

We present on page 459 the portraits of the principal officers of the company and of the technical and business staff. The names and locations of the latter are as follows: General Agent, in charge of the Sales Department, John R. Williams; Assistant, C. W. Woodward. Chief Engineer Construction Department, J. Appleton; Assistant, R. H. Klauder. Chief Engineer Railway Department, J. B. Entz. Factory Superintendent, Carroll Potter. Purchasing Agent, J. B. Falkner, Jr. Manager of New York Office, Mr. Charles Blizard; R. McA. Lloyd, Engineer. Manager of Boston Office, Mr. Frank J. Stone; J. Lester Woodbridge, Engineer. Manager of Chicago Office, Mr. Frank H. Clark; R. B. Daggett, Engineer. Manager of Baltimore Office, Mr. R. C. Hull. Manager of Cleveland Office, Mr. W. O. Knudsen. Agent for the Pacific Coast, Mr. A. E. Brooke Ridley.

In order to secure competent persons to install and operate the batteries manufactured by the company, graduates of the various schools of electrical engineering are taken into the laboratory at the company's works and trained in all the details of the business. After a laboratory course the young men are transferred to the construction department and eventually put in charge of a force of men employed in the construction of plants. In this manner the company is always assured that its work is in the hands of intelligent and trained men, and to that fact may be ascribed the high character of its work wherever installed.

LETTERS TO THE EDITOR

The Facts as to Aluminum and Copper for Conductors.

IN The Electrical Engineer of March 31, 1898, in an editorial entitled, "Aluminum versus Copper for Electrical Conductors," you refer to the discussion of Mr. Alex. Dow of the paper of Mr. Jesse M. Smith, before the Detroit Section of the Association of Engineering Societies, in which Mr. Dow claims that the increased diameter of aluminum wire necessary for equal electrical conductivity over copper wire would increase the stress along the approximately horizontal line, due to wind pressure; this stress being proportional to the projected area normal to the line of stress. In other words, his inference is that the increased diameter of aluminum wire would require a much greater transverse strength of poles or much heavier bracing against wind pressure.

This inference, however, does not take into consideration the fact of the very much decreased dead-load of the aluminum over the dead-load of the copper span of equal electrical conductivity. The facts in the case are that 48 per cent. of the weight of the copper will give a section of aluminum wire of equal electrical conductivity—that is, the section will be 100 for copper to 160 for aluminum, while the weight of the copper in any given length, say, 1,000 feet or a mile, will be as 100 of copper to only 48 of aluminum.

When this factor is taken into consideration, the strain upon the poles due to the use of aluminum line of equal electrical conductivity is found much less, even with the added wind pressure, than the copper line of equal electrical conductivity.

Mr. Dow in his discussion of Mr. Smith's paper claims that the added section of the aluminum line would have to withstand increased snow load. This is a matter which I am told by engineers who have had large experience in it, is not the case, as the snow load seems to be almost independent of the actual size of the suspended wire.

As to the tensile strength of the wires, the aluminum can be furnished with a tensile strength of 40,000 pounds per square inch, while the hard-drawn copper wire will have a tensile strength of, say, 65,000 pounds per square inch. The section of 160 for the aluminum to 100 of copper will have an equal, if not slightly greater, tensile strength for the line than will the copper; so that the facts which have already been proved, that aluminum lines of equal electrical conductivity will withstand both wind and snow loads superior to copper wire, can be proved by theory as it has already been demonstrated by practice.

In this connection, I would quote from a letter of March 14, received from Mr. D. H. Fitch, of the Telephone Exchange at Cazenovia, N. Y., as follows: "In regard to further use of aluminum wire, I shall have use for a little of it for special work this spring. All thus far used has done splendidly. I was a

little apprehensive of the last, on account of being so soft, but it has stood the storms thus far without the least impairment. The last put up were about 450 feet spans. The long span (nearly 600 feet) has now stood through two winters and is in perfect condition—just where I put it; has not stretched or sagged. I have an inquiry from Canada, which I herewith enclose. I have said to him that 'my use of aluminum is most satisfactory, and if I had this exchange to build to-day, I would use aluminum wholly for line work.' "

The writer is glad to acknowledge the great value that the development of the metallurgy of aluminum has received from electrical engineering, but respectfully maintains that it is not yet proved that the electrical engineering profession has not much yet to expect from the metal aluminum.

THE PITTSBURGH REDUCTION CO.,
Alfred E. Hunt, President.

Pittsburgh, Pa., April 15, 1898.

The Town of Hudson Has Had Enough.

The following I have clipped from the Boston "Evening Transcript," of April 16, 1898:

"The town of Hudson, which owns a municipal lighting plant, has concluded that it cannot sell electricity to consumers at a price on which it can make a profit, and so has petitioned the Gas and Electric Light Commissioners for permission to sell for less than cost. Its present price is 20 cents a kilowatt hour. No date has been set for a hearing."

Another demonstration, I take it, of the "business methods" of municipal management as exercised in electric lighting plants.

JAMES I. AYER.

Boston, April 21, 1898.

Liquid Air.

MANY articles have been written regarding liquid air in the last few months, and, like all new developments, there have been many erroneous or misleading statements made. It is a subject which opens up a vast field for the scientific investigator, as we have no data of any importance upon which to base calculations, and to use a common expression, it is a case of "cut and try." I have read several articles lately on liquid air, and nearly all contain statements not borne out by facts. As you are aware, Mr. Tripler has spent years of time and a great deal of money in the liquefaction of gases, and in the past few months he has very courteously shown his apparatus and the liquid air to the public. Articles have been written by persons who have no experimental knowledge and are not conversant with all the data, and the results are statements that are erroneous and misleading, and which are calculated to retard rather than assist the development of the subject. I notice an article in your issue of April 14 by an assistant professor in Adelphi Academy, Brooklyn, Mr. Sol. D. Benoliel, E. E., A. M. His description of the liquefying apparatus is radically wrong, as also is his statement regarding the number of horse power hours required to produce a gallon of liquid air. In the article, he has an illustration entitled, "Prof. Peckham's Vacuum Bulb." Facts will hardly credit the idea to Professor Peckham. If Mr. Benoliel will take the trouble to look up some of the back numbers of "Engineering" and also the "Engineer" of London, he will find that this form of bulb, together with several others, was made by Professor Dewar, before Professor Peckham ever saw liquid air. The assuming of such credits is very unprofessional and distasteful to readers who are conversant with the facts.

In the description of the experiments, courtesy would demand that credit should be given to the originators of these experiments, as nearly all of them were shown to Professor Peckham by Mr. Tripler. In the article in question, the statement is made that in changing a jet of steam into ice, it lost in an instant 1,290 deg. Fahr. This is erroneous, as the drop in temperature is only the difference between 212 and 32 deg. Fahr., or 180 deg. If he had stated that this was a loss of heat units it would have been nearer right. Space will not permit me to extend this criticism farther, but, knowing that a journal of the high standing of The Electrical Engineer always wants accurate data, I have taken the liberty of calling your attention to the above, that your readers may not be misled regarding a subject so important as liquid air.

W. H. DICKERSON.

Newark, N. J.

Electrical Steering Gear.

Referring to the description and drawings of the Pfatischer electrical steering gear, published in The Electrical Engineer of January 13, 1898, I have the honor to state that the apparatus described infringes directly on my patents 381,228, dated April 17, 1888; 385,229, dated June 26, 1888, and 387,714, dated August 14, 1888, as an examination of those patents will clearly show.

BRADLEY A. FISKE, Lieutenant, U. S. Navy.

U. S. S. Petrel, Hong Kong, China, March 6, 1898.

LITERATURE

MODERN SWITCHBOARDS. By A. B. Herrick. Cutter Electric and Manufacturing Company, Philadelphia, Pa., 1898. Cloth. 221 pages. 9 x 11 inches. Price, $3.00.

This book which may be called a compendium on switchboard construction from the beginning of the electric light industries up to the present time, is without a doubt the most complete treatise on switchboards and the appliances used thereon ever issued. It embodies a historical résumé of early practices and expedients, indicating the advance recently made in this class of electric apparatus, besides giving valuable data on improved methods of construction. The book is profusely illustrated by numerous cuts, drawings and designs especially prepared for this publication. The publishers acknowledge their indebtedness to Mr. L. Stieringer, Mr. A. B. Herrick, and Mr. W. H. Tapley for their valuable contributions. Following a very interesting introduction on the advance of the art of switchboard construction, are eleven chapters dealing respectively with circuit-breaking devices, switchboard construction, switchboard appliances, protective devices, low tension switchboards, low tension central station switchboards, railway switchboards, alternating current switchboards, arc light and special switchboards, circuit breakers and their use in power transmission, and an essay by Mr. W. M. Scott on the development of the circuit breaker. The book, though it is issued by a manufacturing company, is far from being solely an advertising medium and is a valuable addition to the electrical literature of the day. We heartily congratulate the Cutter Electric and Manufacturing Company on the production of this splendid volume, which has the two-fold effect of bringing before the electrical public their high grade apparatus, and educating the layman and student in this interesting and scantily understood subject.

THE CALORIFIC POWER OF FUELS. By H. Poole, F.S.C. Published by Wiley & Sons, New York, 1898. Cloth. 248 pages. Price, $3.00.

This book, which was commenced as a translation of M. Scheurer-Kestner's treatises on the calorific powers of combustibles, has undergone changes which became necessary to adapt it to American methods and data. The work embraces only that portion of calorimetric determinations having a bearing on fuel volumes; a concise description is given of leading calorimeters, those most commonly used being described more fully than others, and some examples of working and calculations are added. The book is well and amply illustrated and its chapters contain valuable data on solid, liquid and gaseous fuels, and the calorific power of coal burned under steam boilers. The book being based on American practice, should certainly commend itself to every power user in this country, and it may be said to fill a want which has long been felt by those interested in the generation and utilization of power.

OHIO having tried electrocution, now proposes to give up entirely the death sentence. This may serve as a pointer for Massachusetts, which is proposing to substitute gerrycide for hempen methods.

AM. ASSO. AD. SCI. is to meet in Boston in August and has just issued an interesting circular of preliminary announcements as to committees, sections, excursions, etc.

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Vol. XXV. NEW YORK, APRIL 28, 1898. No. 521.

The Storage Battery Industry in the United States.

AMERICA has never been accused of lack of energy and enterprise in taking up and pushing to successful commercial application any method or device which gave promise of success. On the contrary, the rapidity with which it has created new industries is a matter of familiar history. The electrical arts, especially, have of recent years been the 'favorites upon which brains and capital have been lavished without stint in the United States, so much so, indeed, that this country has become the Mecca for all who would be up to date on the newer applications of electricity. But in justice to European electrical engineers one reservation must be made to the above statement, in so far as it relates to storage battery work. Indeed, it is but a short time back that the American electrical engineer desirous of keeping himself informed of the latest practice in this branch of electrical work was obliged to cross the ocean, a trip which indeed was made by not a few for the specific purpose. A long and dreary story might be written as to the causes that held the storage battery back so long in America, and to enter into it now would be a useless as well as a thankless task. Suffice it to say that the storage battery no longer requires any apologists on this side of the water, and that the American engineer need no longer undertake a trip abroad to study the storage battery question. This happy state of affairs, brought about within the past few years, is surely a subject for congratulation, and vindicates the position long since taken by The Electrical Engineer, that the storage of electrical energy offered one of the most potent means of overcoming the drawbacks under which many of our central stations were, and still are, laboring. Stronger than ever in our belief that the storage battery has a most important mission to fulfill we have in this issue placed before our readers a description of plants typical of the many applications where such an adjunct to the dynamo is not only conducive to economy, but in most cases indispensable. As to the future, one is naturally inclined to look for the bulk of the storage battery work within the confines of the central station, and this anticipation is fully justified by the experience of the past. But a closer study of recent practice, more particularly abroad, would seem to indicate that, after all, there are situations outside of the central station building itself, where the storage battery may be operated with considerable economy, from the standpoint of both the electric light station and the consumer.

It makes little difference evidently, viewed from the electric standpoint, whether the storage battery which equalizes the station load is located within the central station or on the premises of the consumer. But it does make a good deal of difference whether the central station has to pay for the storage battery, or whether the consumer pays for its installation. It must be plain that if the latter be the case, the central station is relieved of a heavy item of expense, for which it ought in justice to the consumer, compensate him in some way or another. This is the principle on which the Berliner Elktricitäts Werke have recently inaugurated a new system, which bids fair to become a pronounced success and to add greatly to the popularity, as well as to the earning capacity of that admirably managed company.

The plan adopted is to urge consumers to install local storage batteries on their premises, which are charged at certain specified times indicated by the company; in this way, by distributing batteries on its circuits, and charging them at scheduled times the load on the engines at the central station can be regulated in such a way that they are practically always running at maximum efficiency.

The normal rate of charge at Berlin is fifteen cents per kilowatt hour, but to encourage the installation of local storage batteries by consumers, the company makes a reduction of close on to 75 per cent. in its rate of charge, so that the actual cost for charging local storage batteries at specified times, is only four cents per kilowatt hour. Startling as this proposition may appear at first sight, we believe that when gone into carefully, it will be found to be thoroughly sound; indeed the mere fact, that so conservative and well managed a company as that at Berlin has adopted this system is sufficient proof that it is a thoroughly practical one.

The record of the storage battery work as described in the typical plants illustrated in this issue, would not be complete without mention of the company which has successfully accomplished the up-hill task of establishing the storage battery on a firm footing in this country. We feel certain that no one will begrudge The Electric Storage Battery Company the credit which is due it, as the pioneer in this department of work, and we are glad to believe that as a result of its intelligent and conscientious efforts the storage battery is now meeting with very full appreciation at the hands of American electric engineers and central station managers.

Practical Uses of Liquid Air.

THE numerous interesting and novel experiments shown of late with liquid air and the description of Tripler's and Linde's method of producing the cold necessary to liquefy air, have, besides awakening interest in this new and marvelous product, opened up the question as to its possible practical uses. No one of course can at this early stage, the period of experimentation, predict the benefits which mankind may derive from this marvelous laboratory production. However, several uses of liquid air have already been outlined, which, if realized, will bring about a revolution in many important industries of the day. In the first place it is not unlikely that in the manufacture of chemicals or explosives liquid air may find practical application, but the two most important uses to which it will probably be put are refrigeration and the storage of power. It is not to be supposed, however, that liquid air will replace ammonia for refrigerating purposes in the near future, as the ammonia refrigerating machine has a very high efficiency; but for special purposes where very low temperatures are required and where it is desired to confine the refrigeration to a small space, liquid air may soon find extensive application. The most important by far, however, of the probable future uses of liquid air appears to be the storage of power. This problem was discussed at length in a recent issue of "Engineering News," from which the following deductions are taken: Of all the methods known to engineers for the storage of considerable power with apparatus of moderate weight and bulk, only two, the electric storage battery and compressed air tank have been commercially developed of late. The new method of using liquefied air, while it is more expensive than the older systems and returns a smaller percentage of the power originally applied, possesses the great advantage of storing many more foot pounds of energy in a cubic foot than any of the systems with which we are familiar. First let us see what advantages liquid air has over the compressed air system as a means for storing power. In the latter system the air is stored under pressures of about 2,500 pounds per square inch. This necessitates the tanks to be made very heavy and the weight and bulk of these tanks are a great drawback to the commercial adoption of this system. Liquid air, however, occupies only one-fourth the space of air at the above stated pressure, and, if the tank containing it is properly jacketed, it can be kept for a considerable time. A safety valve might be

attached to the tank to prevent the pressure from exceeding a certain amount. This economy in space and weight compared with the storage of power by means of compressed air, and the application of a reducing valve so that it can be used at any desired pressure, will at once be manifest. Comparing liquid air with the battery as a means of storing power, it may be stated that a pound of battery stores from 8,500 to 15,000 foot pounds, or about one-tenth to one-twentieth the power that is stored in liquid air. The storage of heated water as a means of power storage compares most unfavorably with liquid air storage; the latter storing about four times as much power for a given weight as the hot water or stored steam system. It should be stated, however, that in all the above mentioned systems the amount of power which may be obtained from a pound of the substances employed is considerably less than that which may be obtained from a pound of any good fuel used in the steam and gas engine for the development of power. While the above comparisons of the various systems certainly places the use of liquid air far ahead of all other known systems, still the employment of it for the storage of power is a possibility of the future rather than an attainment of the present. Much will depend on the efficiency of production and the reduction in the cost of the material. The success achieved, however, points to an early application of liquid air for torpedo propulsion, where cost is a secondary consideration, as well as for the propelling of motor carriages and bicycles where the main consideration is the maximum storage of power with the least possible space and weight.

So much for the use of liquid for the storage of power. Another already commercially practical application is to make an explosive by mixing liquid air with carbon. In a recent lecture before the Society of Arts, Prof. J. A. Ewing gave a very interesting account of the details of the process of manufacture employed by Dr. Linde. The explosive obtained by mixing liquid air, enriched by the evaporation of a large part of its nitrogen, with powdered charcoal, compares in power with dynamite and can be made to go off violently by using a detonator. Cotton wadding impregnated with coarse charcoal powder can take up more than enough liquid air to supply oxygen for its complete combustion and when put quickly into thick insulating cases, made of paper, the explosive power is retained for five or ten minutes. According to the size of the cartridge all this power is lost after an interval varying from fifteen to twenty or thirty minutes. For several purposes this is a decided advantage. On account of the low temperature produced by the explosive which is lower than that required to ignite fire damp, the process has been commercially used in some coal mines in Germany and has been found very satisfactory.

The Value of Exhibitions.

ACTIVE preparations are going on this moment for the Electrical Exhibition, which is to be held next week in Madison Square Garden, and a fine spectacle will be in readiness for the opening exercises of Monday night—exercises which even in these times of war, both the President and the Vice-President of the United States deem important enough to take an active part in, with the intervention of the phonograph, telephone and telegraph. In fact, the existence of war does but emphasize the importance of the electrical arts, for vital functions on our warships, the defence of our harbors and maritime cities, and the patrol of our coasts all depend upon the efficiency of apparatus now to be illustrated. There is, moreover, the other national side to our electrical development, and that is the exemplification in this exhibition of the peaceful apparatus which in growing quantity and value this country is now exporting to all parts of the world. We all know that such a splendid collection of manufactures is what appeals most of all to our noble President, who has spent his life in the endeavor to build up American industries, and who in these latter months has stood out with such magnificent endurance and patience as the exponent of American desires to conquer, not by force of arms, but by reason of humanity, pity and charity.

It is natural that at such a juncture some people should wonder at the courage with which the management of the Exhibition has carried through its great task. There are always those who can throw cold water on an enterprise, impugn the motives of its promoters, hint cynically at its failure, and even do a little to check natural success; and at such periods of crisis as this, a little detrimental effort goes a long way. We venture now to express our belief that the Exhibition will be one of the most brilliant and successful ever held in this city or this country. So far from the war hurting it, we think the effect, so far as attendance and results go, will help it, and that it will be during the month not only a patriotic rallying point, but a centre of the very latest news from the front, illustrative of the facilities afforded by electricity for the swift transmission of intelligence. As was said last week in the New York "Evening Post": "There is always a tendency in war time to a reactionary excess of exciting amusement. The old home life about an evening lamp, of books and music, and family and neighborly recreation, has never returned to us as a people since the long-drawn-out distress of 'the rebellion.' The theatres overflowed, and men loved to congregate together and discuss the questions of the day; the result has been lasting upon all phases of society. Men and women prone to seek causes for social changes can clearly say, 'This came to be the custom since the war.'" The Electrical Exhibition, coming at a time of the celebration of the Greater New York Day, and at a period when war is waging after thirty years of peace, will be but one more proof of the social phenomenon above noted.

But turning to the practical point, the value of exhibitions, it can only be said that they have various desirable features and many undeniable merits. So long as merchants find it profitable to expose their goods for sale in store windows and warehouses, and so long as the public flocks to see such goods, there can be no question as to the justification for holding exhibitions. Just as women go from store to store, however, comparing qualities and prices, so on the other hand people go to an exhibition knowing that they are saved all the toil of such slow processes, and that in a glance and in a brief space of floor and time they have submitted to them all that is latest and best. In addition, they are impressed when they see a number of large and active concerns all putting forward certain specialties or tending rapidly towards standardization in apparatus of whose existence and uses they had hardly any idea. If at all in a position to need or introduce such apparatus, they receive an irresistible impulse to marshal themselves also in the onward movement—and thus the good work is accomplished. It is a matter of absolute record that many notable and great advances in the arts and industries owe great strides to the opportunities afforded by exhibitions to impress and convince the public.

Exhibitors also gain more than they are aware of from their participation. They are apt to say sometimes that they "go in" because another concern does, and that a self-denying agreement to stay out would really be beneficial. This begs the question, for no man who wants to get at the public waits upon other concerns, as to his intention and ability, when it comes to trade literature, advertising, sending out salesmen, or putting up his wares attractively. Besides, the neglect to avail of the opportunity presented by an exhibition often has a bad effect upon a concern, directly and indirectly. Getting ready for the show induces to better effort, things that were dragging are pushed to a finish, what was shown last time has to be excelled; and in one way and another, an exhibit comes to mark a new point of departure from which progress can be gauged and tested. Relatively, also, the man who goes in gains doubly by the abstinence of the man who stays out, and we know of instances where that fact, being realized at a late moment, the absentee has spent far more money than an exhibit would have required, in endeavoring to "hold his end up" in some offsetting manner.

The Exhibition is now upon us, and this article will barely have been read before the Garden will be thronged by crowds of the curious, the wealthy, the young and the progressive in all classes of society, not to forget those who represent the art itself. The management has done wisely in securing the co-operation of the New York Electrical Society, which has lent itself enthusiastically to the work; and in providing for visits of the scores and scores of chapters of the National Association of Stationary Engineers, so that some six or seven thousand picked men operating modern steam and power plants will be brought into direct, close touch with all that is latest and best in electrical development. In other educational ways, with lavish liberality, the management has provided features of attraction and instruction, and we rest confident of the results.

Municipal Electric Lighting.[1]—X.

(Concluded.)

BY PROF. JOHN R. COMMONS.

OPERATING EXPENSES OF MUNICIPAL AND ELECTRIC PLANTS.

Below, I have compared the operating expenses of the two largest American municipal stations which have published the records of their output in kilowatt hours, with the four cities, Glasgow, Manchester, Dublin and Aberdeen, and have also inserted Foster's estimate for the fourteen American municipal stations noted above in Table V, and his citation of Crompton's English stations. The high labor cost of the American stations is noticeable, but notwithstanding labor in Allegheny and Detroit is 145 per cent. and 152 per cent. higher than in Manchester and Glasgow respectively, and the cost of fuel is but slightly different, yet the total cost for the American cities is but ten per cent. higher than that of the two model British municipalities, and but little above Crompton's ideal English station. The smaller American municipalities, although bearing nearly double the labor cost, have a total cost less than five per cent. above the twenty-three English stations.

TABLE XV.

COMPARISON OF OPERATING EXPENSES PER K.W.

	Year ending	Total k.w. generated at the station.	Labor.	Fuel.	Supplies.	Repairs.	Office.	Miscellaneous.	Total.
Allegheny....	March 1, '97	2,711,631	.0106	.0060	.0064	.0026	.0014	....	.0272
Detroit.......	June 30, '97	2,980,412	.0222	.0055	.0043	.0017	.0033	......	.0370
14 Am. municipal stat'ns Foster.......		......	.0251	.0173	Suppl	ies &	Office	.0161	.0585
Glasgow.....	March 3, '96	1,279,687	.0088	.0083	.0018	.0088	.0069	.0009	.0355
Manchester ..	March 3, '97	3,028,357	.0044	.0066	.0015	.0055	.0049	.0013	.0242
Dublin	Dec. 31, '96	718,074	.0172	.0213	.0032	.0080	.0049	.0004	.0550
Aberdeen	Dec. 31, '96	236,649	.0097	.0046	.0017	.0137	.0093	.0022	.0411
23 English stations : Crompton....		......	.0144	.0222	Suppl	ies &	Office	.0194	.0560
Ideal English stations : Crompton....		......	.0040	.0054	"	"	"	.0170	.0264

IMPORTANCE OF COMMERCIAL LIGHTING.

The foregoing comparisons have dealt mainly with American street plants. But it is an unfair comparison which looks mainly at street lighting. Even more important is the relief of the private consumers from exorbitant charges. Incandescent lighting can be furnished at ten cents per kilowatt hour or one-half cent per lamp hour—one-half the usual private rates—and yield a large profit to the municipal plant. At this rate it is cheaper than gas and more wholesome and convenient. Besides, electrical power can be furnished at much lower rates. The only failures of municipal plants hitherto reported are those which furnished street lighting alone, and the so-called greater success of the private companies which took the place of the municipal failures has been based on their commercial business. One or two examples will show the great importance of this side of municipal lighting.

Jamestown, N. Y., operates 275 street lamps of 1,200 candle power each an average of six hours per night or 2,200 per year, and 1,200 sixteen candle power incandescents in alleys and public buildings. The latter at three hours per night are equivalent to 100 arcs making a total of 375—1,200 candle power arcs. The operating expenses and insurance are $19,122.16; interest on bonds ($72,000, at four per cent.), $2,880; lost taxes and depreciation on cost of plant ($74,000, at four per cent.), $2,960; total cost $24,707.16. The commercial income from 1,500 lamps is $5,913.89, leaving a net cost to taxpayers for public lamps of $19,028.27 or $50.79 per year, or $.0231 per lamp hour. The only other cities of New York reported in Johnson's "Electrical Directory" as having 1,200 candle power street lamps are the following: Elmira—335 lamps at $102.20 per year, all night, every night, $.0281 per lamp hour. Middletown—32 lamps, at $108, all night, every night, $.0293 per lamp hour. New Brighton—100 lamps, at $100, all night, every night, $.0274 per lamp hour. Not considering that the cost per lamp hour should be much less where lamps are burned ten hours instead of six, the cost to Jamestown is one-half cent per hour less than in the other cities or eleven dollars per year per lamp, a saving of $4,125. The commercial customers of the city pay $6,000 per year which is a saving of $3,000 for them as compared with their former payments to the private company. Further, the private company still furnishes 10,000 incandescents, 188 arcs and 200 horse power, on which the reductions in charges have been fully $10,000 and probably $20,000. The total saving to the city therefore has been probably $25,000 yearly.

Lansing, Michigan, pays its municipal plant $10,000 yearly for 117-2,000 candle power lamps, moonlight schedule, all night, and the plant receives also $15,000 for private lighting, making a profit for the plant of $7,000 yearly above operating expenses and interest. The rates are twelve cents per kilowatt, being a reduction of eight cents below the rates charged by the private company whose plant the city purchased. The saving to the citizens on commercial lighting is therefore approximately $10,000 per year.

PRIVATE OWNERSHIP PRODUCES CORRUPTION.

The foregoing statistical comparisons may be taken as indicative that the great majority of the 200 or 300 cities and villages now furnishing light are actually getting better service at less cost than those which depend upon private companies. It is objected that such cannot be the case, especially in our large cities, because of the flagrant municipal corruption and inefficiency. Business ability and integrity are excluded from municipal office, appointments are made as a reward of political service, and the municipal plant soon becomes burdened with barnacles who draw pay without work. I do not deny that such is often the case. But I maintain that nine-tenths of the existing municipal corruption and inefficiency results from the policy of leaving municipal functions to private parties; and that an essential part of the present unparalleled awakening of civic conscience on the part of all classes of the people is the desire for municipal ownership of franchises. As the people become aroused to the degradation of their politics and the need of reform, their attention is concentrated on the chief source of that degradation, the under-handed and often high-handed domination of city officials and machine politics by the corporations whose life is maintained by city franchises. It is from them that the politicians get their campaign funds. Contrast the results of municipal ownership above given with the following:

In a city of 100,000 population a private company is organized in the early days of electric lighting with a capital of $100,000 supposed to have been actually paid up. In 1889 the company is "reorganized," increasing its capital by $130,000, $50,000 of which is for a "license" to use incandescent lights which it had already been using for several years, selling the entire increase in capital at from ninety to par. It has a contract for municipal lighting at $144 per arc per year, but has no definite franchise for private lighting. In 1890 a new company of eminent and respectable citizens is organized, at the head of which is the "boss" of one of the political party organizations. This gentleman has associated with him nine prominent citizens who control the avenues of public opinion, all the newspapers, directly or indirectly, and both political parties. They come before the Common Council promising cheaper light. They get a franchise from the aldermen by well known methods. They invest only enough money to erect two or three poles and so hold their franchise. They then make overtures to the old company which again is "reorganized." This time the capitalization is increased to $1,640,000 in stock and bonds, of which $400,000 in stock is given to these ten respectable citizens who procured the franchise, and $750,000 of which is in bonds at six per cent. interest, making a fixed charge of $45,000 in interest yearly on a plant that could be duplicated for less than $1,000,000. Here is a case where ten of the most respectable business men and lawyers of the city have placed their pecuniary interest in direct antagonism to good and honest government. They have become the powerful opponents of all public spirited officials who attempt to get fair terms for the city in this par-

[1]Municipal Affairs, Dec., 1897. A Reply to R. R. Bowker. See Elec Engr.

ticular business of controlling the supply of electric light and power, and no matter how they may afterwards "reform" and demand honest government, the people at large have learned to discount what they say and to distrust their efforts in subsequent movements for civic reform. Strangely enough, two or three of these very same men, being appointed without salary to positions on the Board of Water Commissioners to construct and operate a water works plant owned by the city, exhibited the very highest integrity and patient industry in promoting the city's interests and constructing a plant of which the citizens are justly proud.

We may call upon our eminent business men to arouse from their lethargy and to take an active part in municipal reform, but so many of them have been mixed in these "jobs" that the people at large have no confidence in their leadership nor in any candidate for office whom they are known to advocate. Such business men need reforming themselves, but this is to be done, not by appealing to them after the method of the revivalist, but by removing temptation from their way and giving them an opportunity to really serve the community in a public and honorable way through the employment of their distinguished business abilities. Private ownership of municipal monopolies forces them and all whom they can influence to oppose the good of the city. Municipal ownership makes it to their interest to place their abilities at the service of the city and to take an honest pride in the good they can contribute to it.

I do not for a moment deceive myself by thinking that this movement for municipal ownership is child's play, or that the companies now in possession will relinquish their hold without resorting to the most determined and unscrupulous devices. There are many indications that they are organizing throughout the country for an attack both upon municipal ownership and upon the integrity of municipal officials.

These concerted and unscrupulous attacks upon municipal integrity need not be looked upon as discouraging. More than anything else they will arouse the common people from their lethargy, and will disabuse them of their fond reliance on mere respectability as a guaranty of public spirit, will direct their attention to the true source of municipal corruption, and will discipline them in organized resistance and in aggressive movements upon the citadel of the corruption funds. In the end this discipline and organization will be the guaranty of efficient administration when once ownership is obtained. It is only in those cities like Detroit which have had a hard training for several years in open battle with the franchise holders, that we may look for that alert public spirit and jealous determination which will make municipal ownership a lasting success.

ADMINISTRATION REFORMS RECOMMENDED.

It is this struggle with monopolists, too, which will force the people to the adoption of administrative machinery better adapted to municipal operation of industry than any that we now have. It must be confessed that the legal organization of our municipalities is not yet perfected for the espousal of public ownership on any large scale. The experience of English and many American cities indicates the following administrative reforms as necessary to accompany or precede municipal ownership.

1. State supervision for cities, similar to that of the Local Government Board of England or that of the Board of Gas and Electric Light Commissioners of Massachusetts or of the Public Examiners of Minnesota and Dakota. A State Municipal Board like that proposed in New York by the Commission on Cities of the Third Class, would prescribe that most important requisite, uniform methods of municipal bookkeeping, would audit accounts of cities, and would direct the proper entries for new construction, depreciation, etc. Such a board would sanction loans and set the terms of years for repayment and the provisions of a sinking fund. In this way the constitutional limitation on municipal indebtedness could be replaced by a more elastic limit, on the principle that the acquisition of a productive property is really a lessening of the city's net debt instead of an increase. The board would publish annual reports giving details concerning finances, costs of production, revenues, etc., of the various cities, thus furnishing the basis for intelligent improvement in administration and for further acquisition of municipal plants.

2. The substitution of unsalaried Municipal Boards or Commissions instead of the Board of Aldermen as the administrative head. These boards should be composed of five or six members elected by the people or appointed by the mayor, one member to be chosen each year for a term of five or six years, thus giving continuity of service. The legislative branch of our cities has so hopelessly decayed that, until something like proportional representation is adopted, no additional powers should be granted to it. The successful electrical plants throughout the country in larger cities are under control of commissions. Wherever the spoils system and corruption exist we may expect to find the aldermen in control.

3. The Referendum and Initiative. The referendum is already universal upon all questions of purchase or installation of a municipal plant. It should also be required along with the initiative upon questions of the sale or lease of a plant, and the appropriations for improvements. Had it been in force in Philadelphia, it is needless to say, the recent scandalous lease could not have been consummated. Councils of that city refused to submit the question to the people although earnestly petitioned to do so by the Municipal League. The obligatory referendum is also necessary as the only thorough means for banishing bribery and the corrupt use of money from municipal politics.

4. A civil service reform system in which the superintendent or electrical engineer at the head of the plant should be appointed on merit and held personally responsible, and then should be entirely free to appoint and remove all subordinates without interference from an outside civil service commission. This is the practice generally where a board of commissioners, instead of the aldermen or mayor, has charge of the plant.

TELEPHONY AND TELEGRAPHY

The New Building of the N. Y. and N. J. Telephone Company, Newark, N. J.

ONLY a few weeks ago we had occasion to describe and illustrate the magnificent new exchange building of the New York and New Jersey Telephone Company in Brooklyn, N. Y.,

NEW EXCHANGE OF THE N. Y. AND N. J. TELEPHONE CO., NEWARK, N. J.

at which time we called attention to the rapid and phenomenal growth of this company. Not alone in Greater New York, but in New Jersey as well, has the company made rapid strides and outgrown its quarters which afforded ample room a few years ago. Another evidence of its growth is furnished by the news that within a month work will be started on the com-

pany's new exchange in Newark, N. J. This edifice, shown in the illustration, will stand on the site of the present quarters, 158-162 Market street. It will have a frontage of forty-eight feet on Market street and a depth of ninety feet. It will be three stories in height and will be so constructed that three additional floors may be added without interfering with the tenants or the business of the company. There will be two store fronts with the entrance between them. The second floor will be divided off into private offices. On the third floor will be the offices of the company. The material will be fancy mottled brick, with terra cotta and stone trimmings. It will greatly enhance realty values in the neighborhood of Broad and Market streets and altogether will be an imposing structure, which will combine utility with architectural beauty and stability. Its interior has been especially planned and arranged to accommodate and expedite the work of the various offices and departments of the company whose business it is to afford oral intercommunication between the thousands of Newark's business men, and those of the thriving suburbs which surround it on all sides, and between hundreds of private homes in this metropolis and other neighboring cities.

Practical Features of Telephone Work—VII.

BY A. E. DOBBS.

GUYS, BRACES, ETC.

Poles on curves and corners need to be well guyed or braced, for if there is one thing which is more aggravating than any other, it is to have the wires continually getting slack, because the corners give way.

The proper method of guying is, however, the sticking point with some otherwise good construction men. Figs. 17, 18, 19, 20 and 21, show the various correct and incorrect methods of

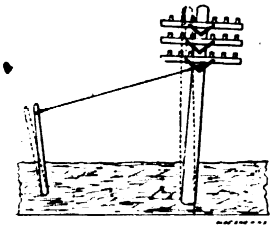


Fig. 17.

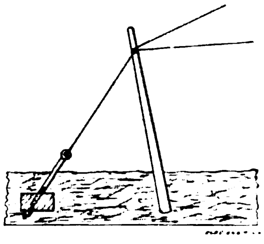


Fig. 18.

holding corner poles in place. In Fig. 17 we have a method of guying often seen, but none the better for all that. No matter how often the wires are pulled up around this corner they will get slack, for the stub will keep yielding to the strain, even though it is seven feet in the ground. The dotted lines show the original position of pole and stub. The guy is placed under the third arm, and the top of the pole itself will spring over several inches. The guy should have been placed just above or just below the top arm, or better still, two guys, one at the top and one below the lower arm. In putting guys on a pole, always place them so that the arm will be free for removal at any time.

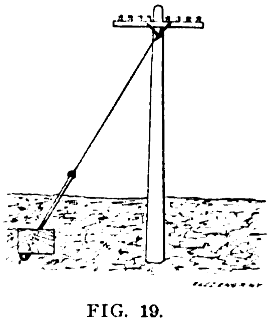


FIG. 19.

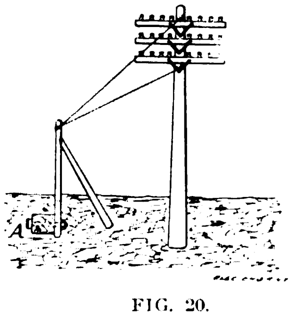


FIG. 20.

In Fig. 18 we have the most approved way of anchoring a stub so that it will stay. The anchor is a heavy block at least 4 feet long, and buried from 4 to 6 feet deep (a railroad tie makes a good one), from which a heavy iron rod is brought to the top of the ground. If rocks are plenty, weight it down with them and tamp the dirt solidly.

In paved streets it might be well to fill in a foot or two with cement concrete.

In Fig. 19 is shown another method of guying, and the pole shown in Fig. 20 will hold, but in order that the back stub may not pull out, a cross piece about the weight of a railroad tie, and three feet long, should be buried about 3 or 4 feet in the ground and bolted to the stub at A.

In some places where the pull is heavier than usual, as at the terminals of cable spans, etc., the guy may be extended

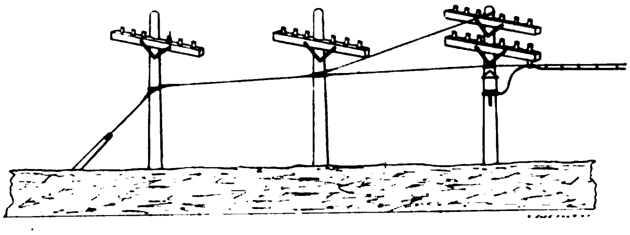
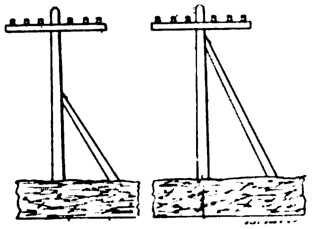


FIG 21.

back over two, three, or even half a dozen poles, and finally anchored, as in Fig. 21. If the pull on the guy is severe enough to mark the poles, a strip of galvanized sheet iron will prevent it, if placed underneath the wire.

These spans should be cut off and made up separately for each section, so that there will be no giving away at any part.

In going through the country, No. 6 wire or even No. 8 will be sufficient for all ordinary purposes, for if a heavier guy than a single strand is needed, two or more wires can be twisted together. Some companies use nothing but No. 9 wire for this



FIGS. 22 AND 23.

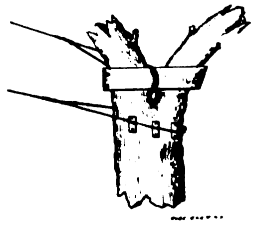


FIG. 24.

purpose. For anchors to stubs, 8 strands are twisted together, while for heavy corners one or more of 4 strands each are used. Cables of this kind can also be bought from dealers. In Figs. 22 and 23 are shown bad and good methods of bracing. In some places the only available places to guy is to neighboring trees. If these trees are shade trees the chances are that their owners will make objections, but the guys can be placed in such a way that the tree will not be injured, if made as shown in Fig. 24.

Where a tree fork is to be had, the method shown in the upper guy is best, the wire being simply fastened to a block and placed in the crotch. If this cannot be done it is better to place it around the tree in a single loop and place blocks behind it. Never pass a wire around the tree so as to compress it since the growth of the tree will be stopped, or the tree will be injured in a year or two.

In "making up" a guy at the ends there are two or three

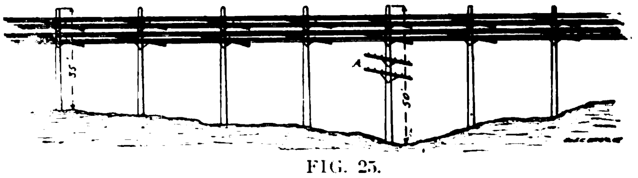


FIG. 25.

things worth remembering. One is that a splice made two feet from the point of support will be stronger than if made closer, and it also affords a chance to twist the wire and take up the slack between the blocks and point of support. Two inches can sometimes be taken up in this way.

In making up a cable, spread out the wires at the ends and twist them all in flat together. This will not only make a neat job but a much stronger splice than any other. The American Bell Company and some street railroad companies often use a clamp for this purpose, which is composed of two grooved pieces of iron drawn together by bolts which clasp the wire. Where guys are expected to stretch and give a little—as they

will in zero weather—a turn buckle will allow them to be taken up or let out as may be necessary.

As regards grading a pole line there are men who take pride in that sort of a thing, putting short poles on top of a hill and tall ones in the low places. One manager who likes this kind of work and having plenty of poles of all lengths, surveyed his line before building, and the result is a line like that shown in Fig. 25. In this sketch poles varying in length from 35 to 50 feet are graded to a level. The point, A, on the 50-foot pole shows how the line would look if the poles were all the same length.

The Cost of Niagara Power in Buffalo.

BY DR. C. E. EMERY.

REFERRING to the article on this subject in the Engineer of April 21, 1898, I am gratified to find that the charges for electrical power in Buffalo have at last been reduced to a rational basis. They are still too high to expect any enormous increase in the number of consumers, but the basis is such that business can be done by the usual commercial system of discounts.

The original proposition to charge for all power on a twenty-four hour basis, though most of the consumers could only use it for ten hours, was grossly inequitable. The company soon found that companies or customers were not anxious to obtain power delivered in the outskirts of the city, as was at one time proposed, and it is at this late day that it has been decided to take good advice, which by the way, was given them long ago, and bring the power to the customers in quantities and wherever required.

The idea of a fixed charge for service, independent of a pro rata power charge, is correct in principle, was initiated by me in the first sales of steam in New York, and has been accepted as sound by the electric lighting companies. The sliding scale based on the average quantity used during the month is also equitable. There remains therefore only the question of price.

The charges of $50 and $40 for twenty-four hour power to the Buffalo Traction Company were reasonable, and made it for their interest to take a large block of steady power but under the old ruling we know they were careful to provide for their variable power with steam. The new rule will in part overcome the difficulty, but the comparison for the multitude should be based on ten-hour power, or, say, 3,000 hours per year.

Let us see what the new prices mean, on a safe basis, that one kilowatt hour will produce one net horse-power per hour.

The $1 per month or $12 per horse-power per year for "service" based on the power the user requires kept available for him, that is, on the maximum power he requires, will, if his average power is two-thirds of the maximum, be a constant charge of $18 per horse-power per year for his average power. If the power factor be $^9/_{10}$, this charge becomes $13.33 per horse-power per year.

The energy is to be delivered as electric current, not as power, therefore the consumer must put in his own interior connections, high tension motor, or more generally transformers and motor, at a cost which should be less than $20 per horse-power for large installations, and may amount to $40 per horse-power for small installations and distributed power. Allow, say, $2 to $4 per horse-power per year, or 10 per cent. on the above for interest and depreciation.

Starting with the smallest item given in table of costs, 1,000 k. w. hours per month would give 4 horse-power for 25 days of 10 hours, or 250 hours. At 2 cents per unit (namely, k. w. hour) each horse-power will cost for electric current (3,000x $0.02=) $60.00 per year. Adding interest, $4, as above and for cost of service if 50 per cent. extra power is to be kept available as above, namely, $18, we have as the cost per horse-power of 4 average horse-power $82 for a year of 3,000 hours, which is not at all unreasonable for that amount of power if some saving of labor results compared with steam power.

Comparing the largest item given in table of costs: 80,000 units per month is equivalent to 320 horse-power for 250 hours. One horse-power at 0.66 cent per horse-power hour will for a year of 3,000 hours cost $19.80 for current. Adding $2 for interest and $18 for service, with 50 per cent. of power kept in reserve, makes the total cost $39.60 per horse-power per year, and for only 10 per cent. kept in reserve $34.80 per horse-power per year. If a saving of labor resulted compared with steam power there would be a slight inducement to pay the smaller price for 10-hour power. For power varying greatly, steam would be cheaper. The company is already selling 24-hour power at the higher rates, though in larger blocks. However, where the heat from steam boilers or the smoke from chimneys is undesirable, of course electricity will be taken at almost any cost.

Before the business is made a success the company must realize that it is necessary to deliver power, not current. That is, they must themselves install the motors and the transformers if high tension motors are not used. The company could generally do this work for less than $20 per horse-power and charge interest on the capital invested. If the consumers are left at the mercy of the trade there will probably be $40 expended per horse-power for the small installations and frequently as much for the large. Moreover, if the business of the consumer ceases, as happens frequently, the motors in his hands will not be available assets at full price, whereas in the hands of a supply company they will be practically as good as new stock.

With this very evident and simple change and a proper scale of discounts, particularly for the higher powers, we should begin to see sales of considerable electric power in Buffalo at points convenient to the distributing stations. Parties served from the original stations of course cannot fare as well.

A 1000 Horse Power High Voltage Transmission Experiment at Odgen, Utah.

IN interesting experiment in high voltage long distance electric power transmission, pregnant with influence on all transmission work was recently made at Ogden, Utah, in order to ascertain the limits within which high voltage currents might be used commercially. The experiment was made by Mr. F. O. Blackwell, of the General Electric Company, over the lines which connected the great power station of what was, until recently, the Pioneer Electric Company at Ogden, with the distributing circuits at Salt Lake City, and consisted in connecting the Salt Lake ends of the transmission lines together and dividing the transformers at Ogden, normally used for raising the pressure of the current for transmission, into step-up for the outgoing current and step-down for the incoming. The distance from the power station at Ogden to Salt Lake City is about 36½ miles. Making a complete circuit of the outgoing and incoming lines, therefore, with Salt Lake City midway, gave a complete transmission circuit of 73 miles over three No. 1 wires. The amount of power transmitted amounted to 1,000 horse-power, and the voltage at which the transmission was effected reached at times as high as 30,000 volts. The current on the return was delivered to resistance vats at the power house, consisting of three wooden tanks.

By careful and repeated measurement with wattmeters at both ends Mr. Blackwell ascertained that this power was transmitted with the loss of only 9 per cent., including 4 per cent. loss in the two sets of transformers. The drop in pressure due to inductance was practically nil, the capacity of the line being sufficient to compensate for reactance loss.

Continuing the experiment, part of the Salt Lake City station load was run from Ogden, with current at 24,000 volts. This was supplied to about 500 horse-power in synchronous motors and lights for two days, under most severe climatic conditions—rain, fog and snow alternating. In addition a severe thunderstorm prevailed all through the night; the lightning arresters discharging repeatedly. Notwithstanding the severity of the conditions under which the test was made, the motors operated without failure and the lights burned without flickering even during the times of lightning discharges. Not the slightest difficulty of any kind developed while this experiment lasted.

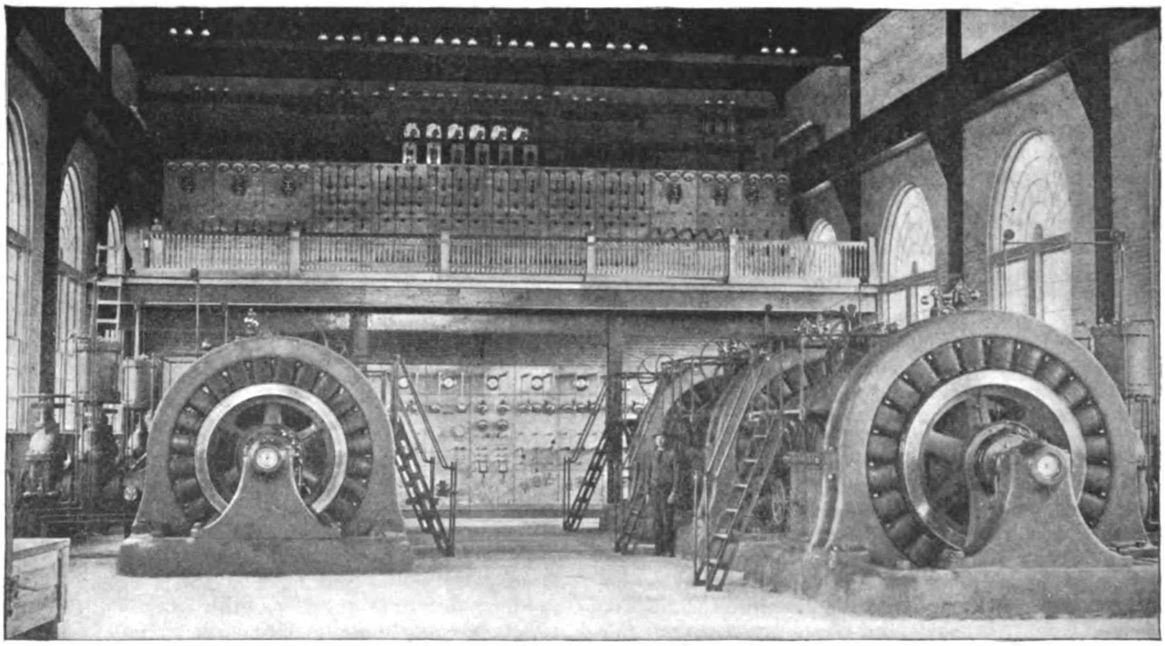
By the recent accomplishment of a scheme of consolidation all the electrical plants in Salt Lake City, as well as the transmission plants, supplying current from it to the outside, have been merged into the Union Light and Power Company. The companies thus consolidated were the Pioneer Electric Power Company, the Salt Lake and Ogden Gas and Electric Company, the

Big Cottonwood Power Company, the Little Cottonwood Power Company, the Citizens' Electric Light Company, and certain smaller interests.

The plant of the Pioneer Electric Power Company is one of the most important installations in the West, and the transmission one of the longest. The power house, shown in the illustration, is located a short distance from the mouth of the Ogden Canon. The power is derived from the Ogden River, the water being brought to the power house through a wooden stave pipe and riveted steel pipe line about 32,000 feet long. The electric plant consists of five General Electric three-phase alternators—24 pole machines running at 300 revolutions, and delivering 750 kilowatts each at 2,300 volts and 60 cycles. The complete plant is designed for 10 units, or a total output of 10,000 horse-power. The exciters are General Electric six-pole 500 volt kilowatt dynamos, each of ample capacity to excite ten generators. Each alternator is directly connected to a Knight water wheel of 1,200 horse power capacity, and each exciter to one of 135 horse power capacity.

The current is fed into the transmission lines from the step up transformers at 16,000 volts, and delivered to the step down transformers at 13,800 volts. They are ordinarily connected in delta, but can also be connected in Y to raise the potential to 25,000 volts whenever it is desired to run at the higher potential in order to increase the capacity of the line or the distance over which the power is to be carried. The switchboard panels on the gallery at the end of the power house are for the outgoing feeders and are arranged to handle potentials of 25,000 and 30,000 volts. Everything necessary to control the operation of the electric and hydraulic machinery has been carried to the switchboard panels on the same level as the generators.

Both step up and step down transformers are of the air cooled type and are each of 250 kilowatt capacity. The pressure of the current for local distribution to the smaller transformers at Salt Lake City is 23,000 volts.



LATEST VIEW OF GENERATING STATION OF PIONEER ELECTRIC POWER, CO., SALT LAKE CITY, UTAH.

PROF. CHAS. A. CARUS-WILSON, of McGill University, Montreal, is leaving for England April 19 to deliver the Cantor Lectures during May in London on "Electric Locomotives." Longmans, Green & Co. are about to publish his book on "Electro-Dynamics, The Direct Current Motor." The treatment will be original, and special attention will be given to the subject of acceleration, and the design of motors for rapid speeding up. A complete solution of the problem is given for the first time.

CROWLEY, LA., is installing an electric light plant. Ball engines, built by the Ball Engine Co., Erie, Pa., furnish the power.

Preparations at the Electrical Exhibition.

Madison Square Garden passed into the hands of the Electrical Exhibition management at midnight on Saturday, and an army of workmen at once began, under the direction of Mr. Marcus Nathan and the officials of the Garden, to get the vast arena in order. The work now in full progress is of an extremely interesting nature, and is itself a fine piece of engineering, including steam and water piping, floor laying, platform building, the erection of booths and stalls, and the preparation by the management and exhibitors of a number of special features. Hundreds of busy people are at work not only in every part of the main floor, but in the huge basement, which contains the operative exhibit, and in the Concert Halls and its annexes, where a number of special features are being placed, including the Historical Wax Tableaux, the Edison Magnetic Ore Separation model, the Third Rail (Hartford and New Britain) model, the Parsell Galvanoplastic exhibit, etc.

Mr. Max Osterberg, the electrical engineer of the Exhibition, has moved his office up to the Garden, and is deep in plans and specifications, getting a wonderful amount of work done in a very short time, with the aid of his partner, Mr. Sutton, and a corps of assistants.

The C & C Exhibit at Madison Square Garden.

One of the most interesting exhibits in the May Electrical Exhibition at Madison Square Garden will be that made by the C & C Electric Company, of New York. In the basement of the building, where the operative exhibits will be placed, there will be shown a C & C multipolar generator directly connected to a 25 h. p. Diesel "Rational Heat Motor," the new type of engine which has created such a stir recently in the engineering field of both Europe and America. (See The Electrical Engineer, February 17.) This exhibit promises to attract a great deal of attention, and the C & C Company's new type of multipolar generator will no doubt come in for a great share of favorable criticism.

On the main floor of the building, the C & C Company will have an exhibit occupying 500 square feet of floor space in which

will be shown all their latest types of machines, including their well known types of bi-polar dynamos and motors in several sizes; also quite a full line of their now celebrated closed type ironclad motors and dyanoms. These machines of the ironclad type will be shown, some separately and some in combination with other machinery. The 20 h. p. enclosed ironclad motor will be shown mounted in connection with a Lambert hoist and one of the dynamos directly connected to a Case engine.

The exhibit will also include one of the ironclads fitted up with back gears for speed reduction. Two of the company's slow speed belt type generators will be exhibited and these excellent machines will undoubtedly be greatly admired as they are particularly attractive in design and the workmanship embodied in their construction as well as the materials employed are of the very highest order. Numerous other interesting machines, appliances and parts will be also shown.

A C & C switchboard will form an attractive feature of each exhibit.

The Telephone at the Exhibition.

The New York Telephone Company will make an admirable exhibit illustrative of the operation of the telephone system of this city. There will be shown specimens of the latest styles of telephone apparatus and silence booths for the equipment of public and private telephone stations. Pretty nearly everybody is more or less directly interested in the telephone service nowadays, though few know just how it works. The New York Telephone Company's exhibit will give visitors to the show a very fair idea of just how the service does work as part of the exhibit will be a switchboard in actual operation, which will serve stations at various points in the Exposition building. Trunk lines will run from the Exposition switchboard to one of the main exchanges, so that the stations in the Exposition may not only be connected directly to each other, but also to any station in the city or in any part of the country reached by the telephone systems of the New York, the New York and New Jersey and the American Telephone and Telegraph Companies.

In short, this part of the exhibit will be a working specimen of the Private Branch Exchange System, which has been so largely adopted by big business houses of all classes since its introduction by the New York Telephone Company a year or two ago.

Arrangements are also making for a separate telephone feature which will be the transmission of music from various New York theatres and out of town points every evening during the month of the Exposition. The Exposition Company, the American Telephone and Telegraph Company and the New York Telephone Company are working jointly in the production of this attraction, which is sure to be popular with the general public.

The Gerlach During the Exhibition,

Mr. C. O. Baker, Jr., president of the Electrical Exhibition Company, has engaged a large banquet room and parlors as a general meeting room and headquarters for delegates and visitors, at the Gerlach Hotel, 49 West 27th street, New York city. This will prove a great boon and convenience to all connected with the exhibition.

Historical Wax Tableaux at the Exhibition.

A series of eight illustrative and historical wax tableaux, designed to mark some of the successive stages of electrical development, prepared by Dr. Park Benjamin, Professor F. B. Crocker and Mr. T. C. Martin, executed and arranged by the Eden Musee Company, will be a feature in the Concert Hall.

The series will include the First Recognition of an Electric Effect, when the Syrian woman, centuries before our era, wonderingly perceived light objects flying to her amber spindle; the Mariner's Compass, ascribed to the Chinese and Italians, but probably to be credited to the Finns, in the eleventh century; the Earth a Great Magnet, Dr. William Gilbert, explaining the Terella to Queen Elizabeth, 1600; the First Conductors or Circuits, Stephen Gray, a Charter-house pensioner in London (1720), experimenting on the conduction of electricity; The Leyden Jar, showing the bottling of electricity and the terrible shock to Dean Von Qliest, Canon of the Cathedral in Cumin, in Pomerania, 1746; The Identity of Lighting and Electricity—when Benjamin Franklin drew down the lightning from the skies, 1752; The Beginnings of the Modern Primary Battery or Voltaic Cell, with Galvani's famous frog experiment, 1791, and the Beginnings of Modern Dynamo-Electric Machinery, showing Michael Faraday's famous experiment, 1831.

These tableaux are accompanied by a selection from Dr. Park Benjamin's celebrated library of early philosophical, technical and electrical books, each illustrating some feature or stage of electrical evolution.

Exhibit of the Hebrew Technical Institute.

For some time past the Hebrew Technical Institute has made a great success of its instruction in the technical branches of celetricity, as distinguished from the mere teaching in a manual of trade school. Evidences of the ability of the students under Mr. Ker will be given at the Exhibition, where opportunity is being afforded for an excellent display of the electrical engineering skill of the boys. Not only will a number of instruments be entered for the model-making competition, but these will be supplemented by other instruments and apparatus built by them, to illustrate principles and phenomena. There will also be a complete small plant in operation lighting a small house. A collection of blue prints and photographs will also be included.

Sprague Elevators at the Electrical Exhibition.

Considerable interest is attached to the exhibit of the electric elevator machine for the London Underground Railway, which is to be shown at the Electrical Exposition to be held in Madison Square Garden commencing May 2. The London machines of this type are the largest elevator machines ever built, and were built by the Sprague Electric Company.

Mr. Charles Chamberlain.

Mr. Charles Chamberlain has been placed in charge of the Press Bureau of the Electrical Exhibition. He is well known as a successful press agent, and being familiar with machinery, etc., will be able to the many engineering features of the show.

The Exhibit of The Edison Electric Illuminating Co. of New York.

The exhibit of the Edison Electric Illuminating Co. of New York occupies, in three sections, the first of the larger spaces, containing about 800 square feet, at the right of the main entrance. In it are shown the more important applications of electricity to industrial and household purposes. The central section, surmounted by a dome, is devoted to electric lighting. For incandescent lighting there are miniature and candelabra lamps, ranging from 1 to 8 candle power; standard lamps, from 8 to 100 candle power; reflected ceiling lighting, the lamps being concealed from view, the new reflector lamps, sign lighting, advertising designs, etc. In arc lighting are shown standard and Bijou enclosed lamps, ranging from 400 to 2,000 candle power, and burning continuously with one trimming of carbons from 100 to 150 hours; projectors, for photographic and stage purposes, replacing the calcium light, and the larger focusing searchlights, of sufficient power, if desired, to throw a beam of light fully a hundred miles. Under-supported lamps, feeding from below, very suitable for post and doorway lighting, are also shown. The end section, nearest the entrance, is devoted entirely to electric cooking and heating, the devices being in practical operation. In addition to smoothing irons, tea kettles, chafing dishes, hair curlers, portable stoves, etc., there is shown the new and very ingenious electric heater for repairing bicycle tires. The third section is devoted to power, largely "direct-connected," avoiding intermediate shafting and belting. There are to be seen a printing press and book binding machinery, direct acting pumps, apparatus for ventilation, lathes, drills, et.c A new refrigerating plant, operated by a motor, showing the actual freezing of water, and an electric forge, for welding and other purposes, in which pieces of metal can be instantly brought to a red heat, are for the first time publicly exhibited in this city. The electric fan blowing hot instead of cold air, is also a new device. The arc lamps on the promenade, over the arena boxes, are supplied by the Edison Company, and show its system of street lighting. The Edison Company supplies current for the entire lighting of the building, as well as for the street lamps and its own exhibit. It is also supplying,

directly from its service in the building, the current used in the vacuum tube lighting of the chapel in the Assembly Rooms. That company continues to have the largest connected installation in the world, supplying from its six stations more than 7,500 customers, nearly 370,000 incandescent and more than 5,000 arc lamps and 20,600 horse power in motors, in all an equivalent of 736,000 lamps of 16 candles.

Fine Exhibit of The Walker Co., of Cleveland.

The Walker Company, of Cleveland, are making one of the finest exhibits at the Garden. Mr. J. S. Anthony, of the home office, will be in charge, and is now in the city preparing all the work. The Walker Company will exhibit at Madison Square Garden two of their No. 20 L motors, mounted on truck; one No. 20 L motor, dismantled to show construction; two No. 4A street car motors, mounted; one 50 kilowatt belted alternator; 1 50 kilowatt street lighting generator, direct connected to Armington & Sims engines, Type "S" controllers, assembled and dismantled; railway switchboard complete with feeder and generator panels; ornamental arc lamps; new Walker recording wattmeter, and a large display of photographs of its apparatus. Besides this, there will be a complete section of the new underground conduit with a Broadway car shown in operation.

Demonstrating the Use of Submarine Mines.

Mayor H. J. Smith, of Pompton, N. J., one of the best known experts in the world in submarine explosives, mines, etc., has very kindly tendered his services to the Exhibition management for the demonstration in a special tank of the manner in which harbors are protected, ships blown up, etc., and some of his ingenious apparatus has been loaned for this interesting work by Mr. C. McLaughlin, of J. H. Bunnell & Co. This will probably be one of the most attractive features of the show.

NEWS AND NOTES

Guarding the Long Island Coast.

A party of linemen of the Western Union Telegraph Company are at work putting in wires at the life-saving stations on the Long Island coast to establish direct telegraphic communication with the forts and Governor's Island. A corps of engineers from Willets Point will be stationed at Quogue, while the signal corps of the Naval Reserve will make their headquarters in Southampton. Islip is also to be made a government telegraph station. It is understood that the War Department will in addition establish direct telegraphic communication between the most distant points of Long Island bordering on the Sound and Fort Schuyler, Fort Slocum and Willets Point.

Electrical War News.

The United States Government has cut the Key West cable to Havana and taken control of the cable for all purposes, establishing a strict censorship over messages of every kind. The staff of the Western Union Telegraph Company has been excluded from the office and Captain Thompson, United States Army, has taken charge.

The following letter has been addressed by Willard E. Case, vice-president of the New York Electrical Society, to Professor F. B. Crocker, Columbia University.

"In view of the fact that the efficiency of electrical fighting equipments on land and sea will form a vital factor in the present war, I would submit to you, as the representative of the Electrical Department of Columbia University, and as a member of the council of the American Institute of Electrical Engineers, the following suggestion: That the professional and skilled electricians of our universities, colleges and electrical societies shall form themselves into a body which shall supplement the electrical corps engaged in active work on the water and in the field, to be available to the Government for expert advice in all matters relating to the utilization of electricity in naval and military operations, thus adding to the present regular expert electrical resources of the Government."

The Board of Directors of the New York Edison Electric Illuminating Company authorize the following announcement:

"All employés of the Company now enrolled in the militia or naval reserve organizations of the State, who may volunteer or be called to active service, will have their positions held open until their return, and during absence for such service their salaries will be continued, provided the absence does not extend beyond one year. Those acting under the foregoing should notify in writing their respective Heads of Departments to whom their salaries should be paid during their absence."

The following notice has been posted in the General Electric Works:

"If employés of the company are called by the Government for service it will be the intention and desire of the company to re-employ them at the expiration of their term of Government service if they shall not then be incapacitated for duty."

The company employs about 5,000 people.

MR. W. F. OSBORNE, so long representing the Western Electrician in the East, will become on May 1 business manager of the "National Provisioner," published weekly in this city.

MR. MARTIN INSULL, member of the firm of Sargent & Lundy, of Chicago, the energetic Western agents of the C & C Electric Co., has been in New York City for a week, in conference with President Dwight. He brought some good orders with him and found the factory already running double shift filling contracts for all classes of its well known apparatus.

SOCIETY & CLUB NOTES

New York Electrical Society.

In consequence of the illness of Prof. Sidney H. Short, and the fact that so many of the members of the society are engaged in active work on the Electrical Exhibition, it has been decided to give Professor Short's lecture on "The Outlook of Heavy Electric Traction," during the exhibition.

At the Electrical Exhibition there will be various demonstrations of scientific phenomena and principles by means of models and apparatus, which will be in more or less continuous operation. As the society has been entrusted with a great deal of the work of this kind it would like to secure from among its members the help of volunteers to take charge of various features from time to time; the duty will not be heavy, but will be made as light as possible.

The first applications will be selected, preference being given, as far as possible, in case there be a large number of applicants, to students of educational institutions. The assignment to duty will be in the hands of a committee of the society and the Exhibition Company, and the work of such members will be publicly recognized.

American Institute of Electrical Engineers.

The 124th meeting of the Institute will be held at 12 West Thirty-first street, New York city, on Wednesday, April 27, 1898, at 8 o'clock P. M. A paper will be presented by Professor W. E. Goldsborough, of Lafayette, Ind., entitled "An Economy Test of a Central Station"; also a paper by Charles J. Reed, of Philadelphia, Pa., on "A Novel Form of Thermo-Electric Battery." This paper will be accompanied by experiments with the apparatus described.

Henry Electrical Society.

The 102d meeting of the Henry Electrical Society will be held on Friday evening, April 29, 1898, at Columbia University, 116th street and Amsterdam avenue, in the Engineering Building, Room 302. On this evening Prof. F. B. Crocker will address the members of the society on "The Design of Circuits for Electrical Distribution," the questions of regulation being illustrated by numerous experiments.

ATLANTA, GA.—The shops of the Southern Bell Telephone Company have been pressed into service for building special submarine mine apparatus for het Navy Department.

THE STOCK MARKET

War and Recovery in Prices.

As might have been expected, the moment there was some certainty about things, the stock market pulled itself together, and prices have been better; the net decline for the week has been very small. Want of activity has been the chief characteristic. During the week, the sales of Western Union were 7,154 shares, closing at 85½; of General Electric the sales were 4,880 shares, closing at 31¼. Only a few hundred shares of American Bell Telephone were sold in Boston, at the unchanged price of 247.

Copper is showing a still upward tendency, and is now quoted at 12@12½ cents. Heavy steel rail, Eastern mill is $18 per ton. Owing to Government orders on top of a large trade demand, many lines of electrical apparatus have been much sought after.

MARRIED

Blackwell-Searles.

New York Avenue Methodist Episcopal Church, Brooklyn, was the scene of a brilliant bridal last week. Miss Grace Anita Searles, daughter of John E. Searles, secretary and treasurer of the American Sugar Refining Company, was married to Mr. Francis Ogden Blackwell, of the General Electric Company, Schenectady. Bishop Hurst, of Washington, D. C., officiated at the ceremony, which took place at 8:30 o'clock in the evening. The bride was beautifully gowned in white satin enveloped in a tulle veil. She carried lilies of the valley. Two nieces of the bride, Miss Anita Stearns and Miss Helen Stearns, attended her. They were gowned in white point d'esprit and carried baskets of pinks. The bridegroom was supported by his brother, Mr. Josiah Low Blackwell, of Baltimore, as best man, and his ushers were Mr. Maurice Oudin, Mr. W. L. R. Emmet, Mr. E. A. Carolan, Mr. Stewart Brown, Mr. Frank Enos, Mr. John Conover, Mr. J. Parker Dodd and Mr. Louis Stearns.

A large reception was held at the Searles residence on St. Mark's avenue. Lilies and spring blossoms formed the decorations, which were artistically displayed through the spacious rooms. Mr. and Mrs. Blackwell will live in Schenectady. Mr. Blackwell, though still a young man, has had a long, active and honorable career as an electrical engineer and inventor, and has the hearty congratulations and good wishes of a host of friends.

PERSONAL

Presentation to W. F. Bossert.

W. F. Bossert, of the Bossert Electrical Company, Utica, N. Y., celebrated his fiftieth birthday on April 17. When the men ceased work in the afternoon they presented to Mr. Bossert an upholstered smoking chair of quartered oak, the presentation speech being made by C. H. Scofield. Saturday evening in Music Hall Mr. Bossert gave his employés, members of the company and members of the Maennerchor, a banquet and at its close Professor Zarth presented to the host a handsome Maennerchor badge suitably inscribed.

Mr. George H. Finn.

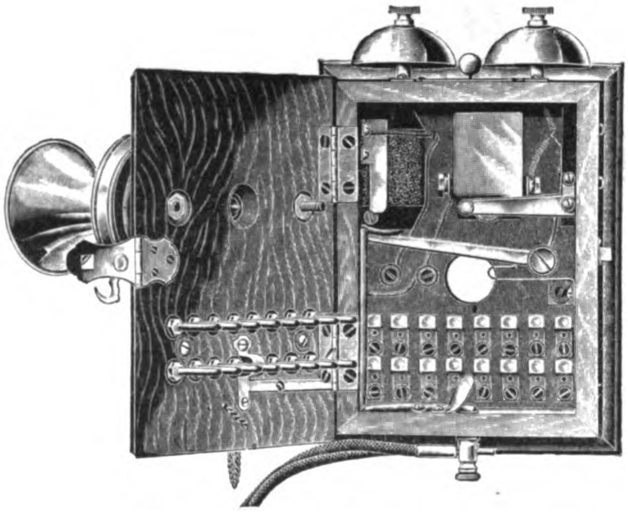
Mr. George H. Finn, formerly secretary, treasurer and general manager of the Edison Electric Light & Power Co., of St. Paul, Minn., has left for Boston, where he has been appointed as general manager of the New England Gas & Coke Co. Mr. Finn has been connected with the Edison Co. at St. Paul since it was started in 1886. Since the consolidation of the electric lightning industries in that city he has also been intrusted with the management of the St. Paul Gas Light Co.'s electric plants.

Mr. Finn was the first to start in St. Paul the system of underground conduits. His management of the company's affairs has been very flattering, and his twelve years' residence had placed him in the front rank of the business men of St. Paul.

TRADE NOTES & NOVELTIES

Schmidt and Bruckner's Improved Telephone Apparatus.

THERE is perhaps no commercial piece of apparatus which can compare in delicacy of adjustment and construction with the electric telephône, and none, considering this fact, which has to stand rougher and more unskilful usage. This unfortunate combination, as will appear evident, makes it necessary that the utmost care be taken in the construction of each detail of the instruments, rendering each portion durable and at the same time sufficiently delicate to have it perform satisfactorily its function in the accurate transmission of the human voice. These facts and the dissatisfaction of the public with



SCHMIDT & BRUCKNER INTERCOMMUNICATING TELEPHONE, OPEN.

cheap telephones which continually get out of order and need repairing, have been carefully considered by Messrs. Schmidt and Bruckner, 209 Greenwich street, New York, in the design of their complete line of telephone appliances.

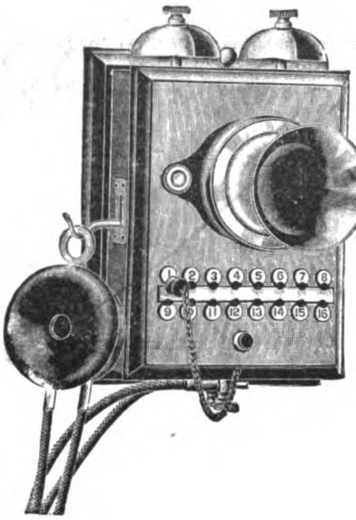
Their transmitter, which is of the coal grain type, is said to be an improvement on the well known Ericsson Swedish transmitter. A thin disc of shellacked silk is used to protect the carbon grain from moisture, and a solid gold disc with projections to increase its surface is used at the back of the diaphragm. These improvements add materially to the efficiency of the instrument and make it much more satisfactory in its operation.

The company's receiver is a very sensitive instrument, is of the double-pole, laminated magnet type and is constructed with the utmost care. The magneto possesses a number of admirable features, among which may be mentioned the long flexible contacts, the centrifugal shunting device, and platinum contacts throughout.

The two illustrations represent the company's very compact wall intercommunicating telephone set. One of the admirable features of the firm's apparatus is the absence of wires and cords inside the box, all interior connections being effected by means of contact between pins and flat springs. The pins, fastened on the door of the box, impinge upon flat spring terminals when the door is closed, bringing the discs on the outside of the box in direct and positive contact with their respective lines. A

double bell arrangement is used which gives a certain and agreeable signal, no magneto, however, being employed. To call any station, it is only necessary to insert a brass plug at the proper disc and push a button. The exterior appearance of these sets is highly commendable and the workmanship is of the very best quality. Compactness is one of the most noticeable features of the company's apparatus, which have met with the entire satisfaction of its users.

Among the latter using the magneto system may be mentioned John Wanamaker, Kerbs, Wertheim & Schiffer, Buckingham Hotel, Uptergrove Bros., Russell, Burdsall & Ward, Long



SCHMIDT & BRUCKNER INTERCOMMUNICATING TELEPHONE, CLOSED.

Island State Hospital, Rathbone & Son, Smith & McNell, Central R. R. of New Jersey, Irving Place Theatre, Weber & Bunke, Trenkman & Co. and Berger & Worth. The following use the company's battery system: Ernest Flagg, Fleming & Kohler, International Exploration Co., Singer Sewing Machine Co., Chilton Paint Co., McKesson & Robbins, Lloyd Plate Glass Co.; N. Y. Quinine Co., A. S. Banter, R. & G. Corset Co., Velvetine Bias Co., Steinhardt Bros., De Fries & Co., Dusseldorf, Germany, and F. Heidrich, of Merida, Mexico.

The Knapp Motor and Gordon-Burnham Battery Combination.

WHAT will certainly prove to be a very effective business combination has recently been entered into by the Knapp Electric Novelty Co., 47 Warren street, New York, and the Gordon-Burnham Battery Co., 82 to 86 West Broadway, New York. The combined outfit (Fig. 3) which these companies will place upon the market will consist of the well known Knapp electric motors, which have been entirely remodeled, are efficient, powerful and thoroughly made, and the Gordon cell, for which long life and efficiency, economy, freedom from local action, gases and odors and low internal resistance are claimed. The Knapp battery motor, shown in Fig. 1, has a three-pole armature, is mounted on a neat mahogany base, and is fitted with a pulley and starting switch. The merits of the Gordon battery are so well known that no further mention of them need be made here. It is equally well adapted for open and closed circuit work, and when used for the latter gives from one to six amperes per hour, with an available e. m. f. of 65 to 75 hundredths of a volt. Besides manufacturing the types of B, C and D motors, the Knapp Electric Novelty Co. manufacture the well known Little Hustler Motor, shown in Fig. 2. The armature having three poles enables the motor to be started without assistance, when the current is applied. It drives a five-inch fan at a high rate of speed, and is fitted with a pulley for running toys, etc. The complete outfit referred to above will be shipped directly from the factory of the Gordon-Burnham Battery Co. This agreement between the two companies in no way interferes with the sale of the Knapp motors without batteries, which they will continue to handle with the same vigor as formerly. We may note that on May 1 the Gordon-Burnham Battery Co. will remove to 594 Broadway, seventh floor, where they will have an enlarged floor space, necessitated by the ever increasing business of this firm.

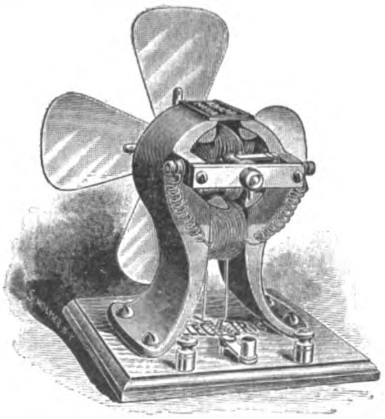


FIG. 1.- REAR VIEW OF C AND D TYPES, KNAPP MOTOR.

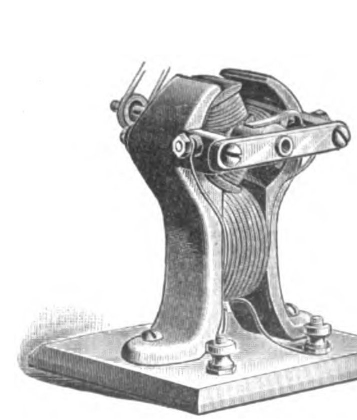


FIG. 2.—"LITTLE HUSTLER" KNAPP MOTOR.

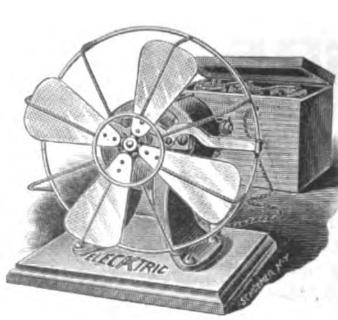


FIG. 3.—KNAPP MOTOR OUTFIT COMPLETE.

Activity of the Sprague Electric Co.

The John Stephenson Company, Limited, have just awarded the Sprague Electric Company another large contract for Lundell power motors with which to equip their blacksmith and machine shops. The John Stephenson Company, as is well known, are erecting a new car building plant at Elizabethport, N. J., and for this plant the Sprague Electric Company have secured contracts for Lundell motors for the mill shops, cabinet shop and blacksmith and machine shops.

The Sprague Electric Company have just received an additional contract for the equipment of the Library of Congress in Washington, with Lundell exhaust fan outfits. All of the outfits will be operated by Lundell power motors.

Lynn Incandescent Lamp Co.

A summary of the winter's business of the Lynn Incandescent Lamp Company, of Lynn, Mass., shows that nine out of ten of their shipments are to old customers and that five out of eight are to lighting stations. This demonstrates that station managers are appreciating their efforts to furnish them with a good lamp at reduced cost, and that they are making it possible and profitable for the station manager to use a lamp of a higher efficiency and to replace them oftener.

It has been a much disputed point as to whether it is cheaper to put money into the renewal of lamps or to use a lamp consuming more power and of longer life than to put money into coal. The nice, bright, clear light of a higher efficiency lamp is certainly the most satisfactory to the customer. The renewal of incandescent lamps certainly appears destined to play an important part in the economy of station practice in the future. The Lynn Lamp Co., however, we believe are entitled to be considered the pioneers and the largest company. At least our readers have seen their advertisements in our columns for the past two years.

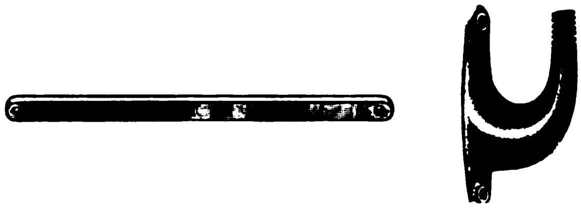
Central Electric Co.

The Central Electric Company, of Chicago, is now furnishing the celebrated Manson tape put up in neat tin boxes, holding one-half pound each. This innovation will be readily appreciated by the many users of this product, as it preserves the tape in a fresh condition and also prevents filings and the many particles of metal always found in a "kit" or on a bench from adhering to the tape and destroying its effectiveness.

The Central Electric Company is carrying in stock a full and complete line of the celebrated McIntire connectors, as well as the various tools used in connection therewith.

Cross Arm Braces and Feeder Brackets of the Coulter and McKenzie Machine Co.

The Coulter and McKenzie Machine Co., of Bridgeport, Conn., manufacturers of electric light and telephone specialties are calling special attention to their improved cross arm braces and feeder brackets illustrated below. The cross arm braces are made up in large quantities of the usual sizes, either plain or galvanized, and are shipped to all parts of the country to large electric light and telephone companies and used to support the cross arms on the poles. It is customary to set one on each side of the pole at an angle of 45 deg., and generally one bolt through the pole connects the two at the lower end. The feeder brackets shown are used for trolley work and generally shipped in black asphalt finish. These goods are kept in stock and can be furnished at once at very low rates.



COULTER AND McKENZIE CROSS-ARM BRACE AND BRACKET.

Sales of Erie Ball Engines.

The Great Northern Hotel, Chicago, will in the near future install a very complete electric plant, consisting of three 225 h. p. Ball cross compound engines, built by the Ball Engine Company, Erie, Pa., each direct connected to 150 k. w. Western Electric generator. The Ball Engine Company are building an engine to go to Mexico. The Rowe Building, East End, Pittsburg, will have an electric plant, Ball engines, built by the Ball Engine Company, supplying the necessary power.

WESTERN NOTES

AM. ELEC. FUSE CO. are now located at 521-531 Wabash avenue, Chicago. Their new works are so equipped that they can manufacture goods with far more speed owing to the improved machinery they have just completed. They are now in a position to turn out any size, shape or form of fuse wire and links for telephone, telegraph, electric light and electric power circuits.

BRYAN & HUMPHREY, Turner Building, St. Louis, have issued an extremely neat pamphlet in reference to the range of their work as consulting mechanical and electrical engineers.

BOARD OF PUBLIC WORKS of Grand Rapids, Mich., who have been advertising for bids for an electric lighting plant have postponed the opening of bids to Thursday, May 5, at 2 o'clock p. m.

THE ELECTRIC APPLIANCE CO. have increased their line of enclosed Upton arc lamps by the introduction of a new enclosed lamp for alternating work. This lamp is giving very satisfactory results and gives every promise of being equal in every respect to the direct current enclosed lamps. The Electric Appliance Company have one of these lamps burning in their store and it has been commented on favorably by all who have watched its operations.

MR. JAMES F. CUMMINGS, the energetic president of the Armorite Company, has, we regret to learn, been ill in Detroit for the past month, but has now entirely recovered, and will in a short time start out on a business tour. He is expected first in the East.

THE WESTERN ELECTRIC COMPANY announces that it has the exclusive Chicago agency for the Sprague Electric Company's conduit and has in stock in Chicago a large and complete supply of interior conduit of all sizes upon which it is prepared to quote the lowest prices.

CENTRAL ELECTRIC COMPANY report that there is an encouraging use of the various electrically heated utensils for cooking and other purposes. The adaptability of this type of apparatus to diversified uses seems to have struck the popular favor. They are carrying all of the various heating and cooking appliances and can make shipments from stock.

GARTON-DANIELS ELEC. CO., Keokuk, Ia., report that business in their Garton lightning arresters is very good. Mr. J. V. E. Titus, the secretary, says: "Business is still holding up to a gratifying extent. Inquiries are coming in in a deluge, showing that wise managers are preparing 'coast defenses' for the impending war of the elements."

NEW YORK NOTES.

THE MANHATTAN ELECTRICAL SUPPLY CO., 32 Cortlandt street, New York City, state that their business has grown to such proportions that the list of people employed by them now exceeds more than 250 men. It is interesting and encouraging to note that this well known concern started ten years ago this month, with one employé, and a capital of less than $100. Moreover, no outside capital was ever invested in the enterprise, its increase arising entirely from the profits accumulating within the business itself and used to push out into new lines and larger fields. Such a record as this must arrest attention. It speaks volumes for the high capacity of the management and for the opportunities that abound in electricity for those who are alert enough to see them and shrewd enough to seize them.

NEW YORK CITY. The New York Edison Electric Illuminating Company reports for March an increase of $56,105 gross and $18,804 net. The gain for three months is at just about the same rate.

McINTOSH, SEYMOUR & COMPANY, of Auburn, N. Y., have moved their New York office in the Havemeyer Building to rooms 1,010 and 1,011, where Mr. Merrill will be glad to attend to all inquiries for their well known steam engines.

CHANGE OF ADDRESS.—A post office has been established at Ampere, New Jersey, and all matter for the Crocker-Wheeler Company there should be addressed accordingly.

THE NORDEN ELECTRIC COMPANY, Broadway and 25th street, Mortimer Norden, manager, report that they have contracted to install over 2,500 lights at the Electrical Exhibition for the following firms: Sprague Electric Co., Electric Storage Battery Co., C. & C. Electric Co., Crocker-Wheeler Electric Co., John A. Roebling's Sons Co., Nash Gas Engine Co., Diesel Motor Co., Thos. A. Edison, Jr., Cutter Electrical and Manufacturing Co., American Circular Loom Co., Paragon Motor Co., Chas. S. Wirt, Hope Electric Appliance Co., The Electrical Engineer, and others.

GENERAL ELECTRIC COMPANY has had to fill a rush order for the Navy Department of 25,000 incandescent lamps, going direct to Key West for the fleet there.

PHILADELPHIA NOTES

QUEEN & CO., INC., of Philadelphia, present in a new circular a description of their Queen Acme portable testing set. Their claims for this instrument as to range and accuracy of measurement are very emphatic. The testimonials in the new circular suggest that the set is widely used, both in this country and abroad. This descriptive pamphlet will be sent on application to those interested.

WASHINGTON CARBON CO. have brought out a patriotic blotter containing a picture of the immortal George together

with a copy of the American flag and a paragraph from the Star Spangled Banner.

MECHANICSBURG, PA., invites sealed proposals until May 10 for 47 or more arc lights of 1,600 candle power, and 12 or more incandescents of 32 candle power, the arcs to burn every and all night, and the incandescents to burn every night until 12. The term of contract is one year. C. N. Owen is chairman of the light committee.

ADVERTISERS' HINTS

THE KEYSTONE ELECTRIC CO., Erie, Pa., remind the public that they are building direct-connected and belted generators for light and power and slow speed enclosed steel motors for the various kinds of service to which this type of motor has been found applicable.

THE C. & C. ELECTRIC CO., 143 Liberty street, New York, advise those who wish to see an exhibition of strictly up-to-date, high grade apparatus to visit their headquarters at the Electrical Show at Madison Square Garden.

JNO. A. ROEBLING'S SONS CO., Trenton, N. J., state that economy in the construction and maintenance of overhead wires can best be obtained by the use of bi-metallic wire, because it possesses sufficient conductivity for all purposes, which insures good service, and it has great strength, which reduces the cost of maintenance.

THE MONTAUK MULTIPHASE CABLE CO., 100 Broadway, New York, are now able to supply interior thermostatic electric cables in all standardized B. & S. gauges. It will be remembered that these cables were recently adopted by the Gamewell Auxiliary Fire Alarm Co.

WILLIAMS & ABBOTT, 154-156 Champlain street, Cleveland, Ohio, claim to be the manufacturers of the best magnets made. They will make special prices on large lots of receivers and binding posts.

THE NORDEN ELECTRIC CO., 145 West 28th street, New York, have installed at the Madison Square Garden the exhibits for a large number of well known electrical concerns of which they publish a list in their "ad."

J. B. COLT & CO., 115 Nassau street, New York, have prepared stereopticon slides which are now ready, illustrative of the Spanish-Cuban question.

THE COLUMBIA INCANDESCENT LAMP CO., St. Louis, Mo., state that their claim of superiority of their lamps would never be maue if there was not foundation for it.

THE FULLER COMPANY, Detroit, Mich., are equipping the finest steamers on the lakes with electric and ventilating outfits.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, say their electrical specialties are factors of success in every first class electrical installation.

GORDON BURNHAM BATTERY CO., 594 Broadway, New York, advertise a battery fan outfit to run 150 hours before renewing battery. The fans are in 6, 8 and 10-inch sizes.

FRANKLIN H. KALBFLEISCH CO., 54 Maiden Lane, New York, make a specialty of battery solutions for telephones and acids for storage batteries.

PALMER ELECTRICAL INSTRUMENT CO., 26 North Seventh street, Philadelphia, advertise electrical apparatus for students, schools and colleges.

THE CENTRAL ELECTRIC CO., 173 Adams street, Chicago, will move the first of May to 264-270 Fifth avenue.

F. A. LA ROCHE & CO., Thirteenth and Hudson streets, New York, advertise the "Ideal" circuit breaker.

THE GRASSELI CHEMICAL CO., Cleveland, Ohio, manufacture the "Snowflake" soldering salt for electrical and other purposes. They also supply sulphuric acid of 1.200 specific gravity for storage batteries.

THE BILLINGS & SPENCER CO., Hartford, Conn., continue to find a ready market for their drop forged fine lake copper commutator bars.

THE HIGH TENSION STORAGE CO., Heed Building, Philadelphia, have a word to say about the methods of charging their batteries.

THE DEARBORN DRUG & CHEMICAL WORKS, Chicago, state that there is no water produced by nature perfectly fit for use in boilers without treating. Their specialty is to analyze a sample of water and then prescribe a solution to suit each case.

THE AMERICAN HARD RUBBER CO., 9-13 Mercer street, New York, announce their succession to the businesses of the India Rubber Comb Co., The Butler Hard Rubber Co., and the Goodrich Hard Rubber Co. They solicit the favors extended to their predecessors.

HART & HEGEMAN MFG. CO., Hartford, Conn., say that in their catalogue "C" all that is latest and best in switches, standard and flush, may be found.

ZAHM & WILLIUS, of St. Paul, Minn., have been appointed consulting and supervising electrical engineers for the municipal puant about to be installed at Superior, Wis. The plant will consist of 200 2,000 c. p. and 300 1,200 c. p. arcs for street lighting, and two 1,000 light two-phase alternators for commercial lighting. Specifications are now being prepared and bids will be asked for immediately.

CRAGE & TENCH, of Buffalo, have secured the contract for building the Lima & Honeoye Falls Electric Railroad. The contract also includes the wiring of the streets of both villages for elecrtic lights, and the construction of the power house. A large force of men will be put to work on the job, next week.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. MAY 5, 1898. No. 522.

ELECTRIC TRANSPORTATION

New Electrical Equipment of the South Side Elevated Railroad, Chicago.

BY J. R. CRAVATH.

THE eyes of the entire electric railway world have been turned for several months past toward the South Side Elevated Railroad of Chicago, which has been changing its motive power from steam to electricity. In making this change two interesting engineering novelties are being made use of, viz.: the Sprague multiple unit system of motor car control and a cooling tower for condensing water for a station of 7,200 horse power capacity, located on valuable city land, where room is limited. These two features alone are enough to arouse un-

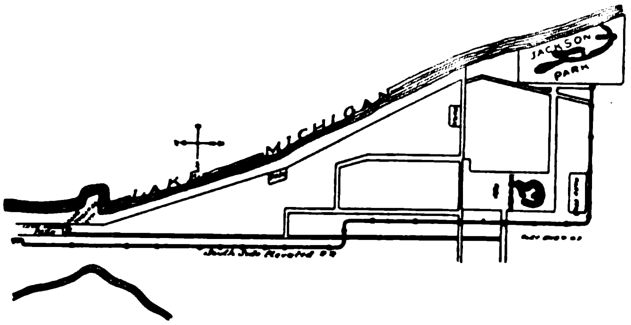


FIG. 1.—MAP SHOWING ROUTE OF SOUTH SIDE ELEVATED R. R., CHICAGO.

usual interest in the installation, to say nothing of the many other details, which deserve attention.

The South Side Elevated Railroad, or, as it is commonly known in Chicago, the "Alley L," (so called because of the location of its right of way) was first opened for traffic in 1892, and at that time its line extended from a down town terminus at Congress street straight south between Wabash avenue and State street as far as Thirty-ninth street. It was extended rap-

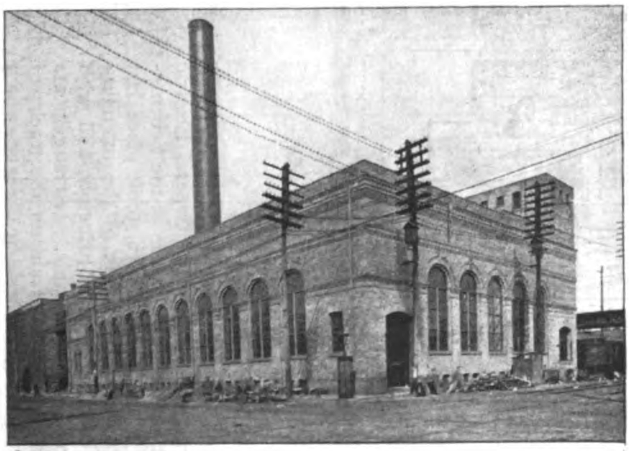


FIG. 2.—POWER HOUSE, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

idly and when the World's Fair opened in 1893 it reached Jackson Park, running direct into the Fair grounds. After the Exposition followed a long period of poor traffic, the road went into receiver's hands, and finally a complete reorganization took place, by which the property passed from the hands of the old company, known as the Chicago and South Side Rapid Transit Railroad Company to the present South Side Elevated Railroad Company. In the meantime the economy of electrical operation over steam, as shown beyond question by the experiences of the Metropolitan and Lake street elevated roads of Chicago, and by the Intramural at the World's Fair, began to excite a strong desire on the part of the South Side management to reduce

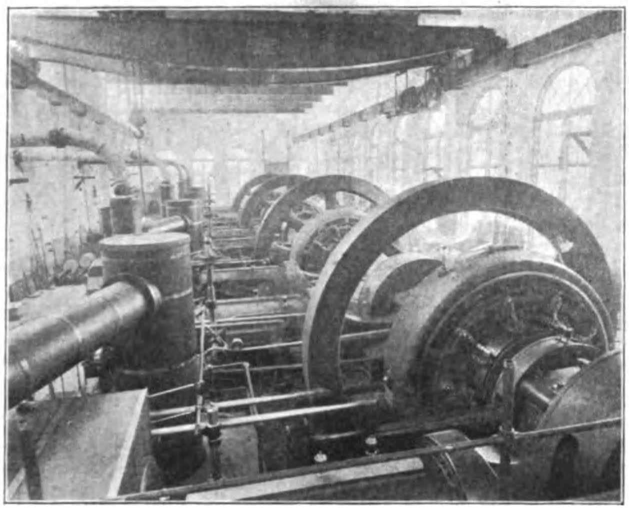


FIG. 5.—ENGINE AND DYNAMO ROOM, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

operating expenses in a like manner, and it therefore was not strange that soon after the reorganization steps began to be taken toward electrical equipment.

In February, 1897, Sargent & Lundy, of Chicago, were called in as consulting engineers to prepare estimates as to probable cost, and in April of the same year it was definitely decided to go ahead with the electrical installation. Messrs. Sargent & Lundy

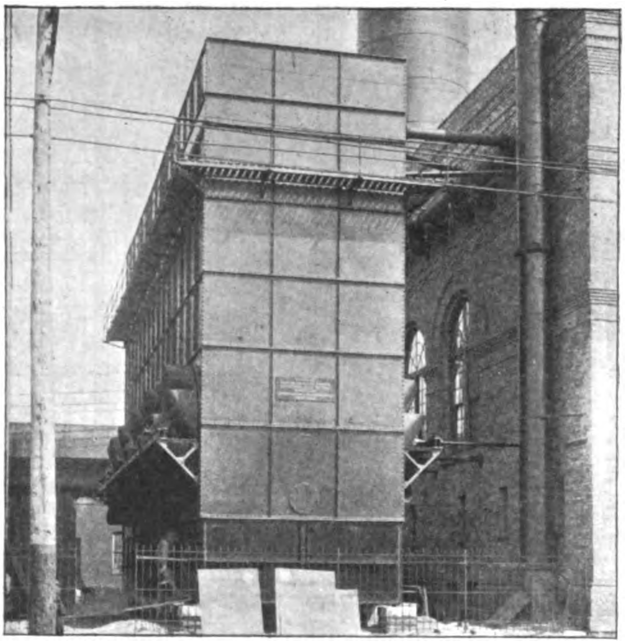


FIG. 6.—COOLING TOWER OF THE SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

were retained as consulting engineers for the entire work. Soon after this Mr. Frank J. Sprague appeared on the scene with plans for the now well known but then scarcely heard of multiple unit system of motor car operation and control. Mr. Sprague's plans were received so favorably that a provisional contract was made with him to adopt the system after the satisfactory equipment

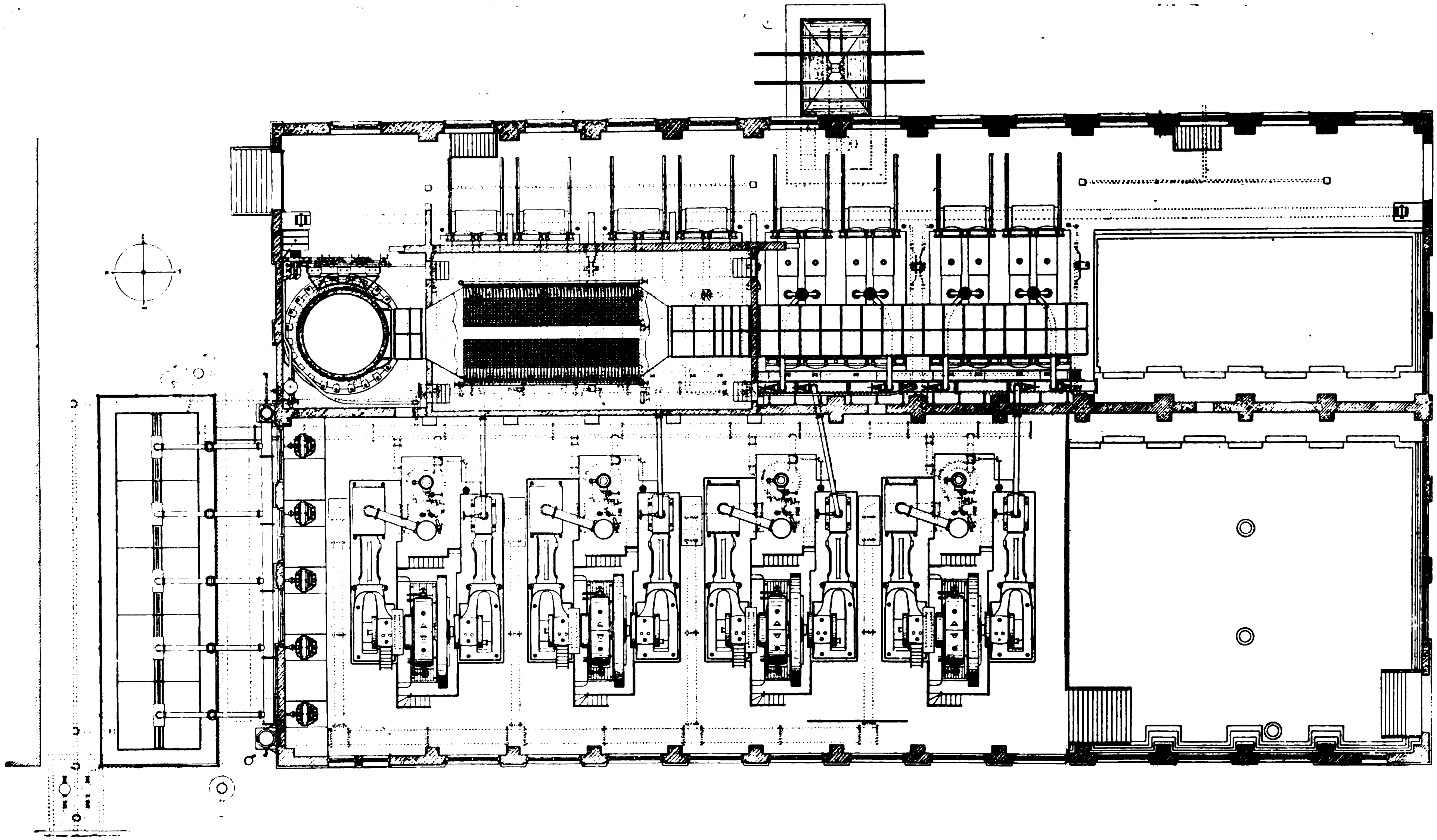


FIG. 3.—PLAN OF POWER HOUSE, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

and trial of a six car train, the cars to be furnished by the road. Mr. Sprague then made arrangements with the General Electric Company for the equipment and tests of six cars at the Schenectady works. This test, as is now well known, took place last August and demonstrated to the satisfaction of the intending purchasers that the system was all right in principle, and with perfection as to details would be practicable. Arrangements were made for another test of a five car train on the tracks of the Metropolitan West Side Elevated Railroad at Chicago, which test took place in December and January last and resulted in the awarding of the contract for the entire equipment with the multiple unit system. The Electrical Installation Company of Chicago was awarded the contract for wiring the cars and placing motors under the Sprague contract, and was also given the contract for running the feeders.

THE POWER STATION.

The road, as will be seen by the accompanying map (Fig. 1), consists of a single route running from Sixty-third street and Stony Island avenue to Wabash avenue and Congress street,

where it joins the Union Elevated loop operated over by all the elevated roads of Chicago. It is about 8.3 miles long. At its southern end it is a competitor of the excellent suburban service of the Illinois Central. The rest of the way its chief competitors are electric and cable surface lines.

The power station shown in Fig. 2 is located at Fortieth and State streets, adjoining the structure. This is a location desirable from many standpoints. In the first place it is near the centre of distribution or load centre of the road, being approximately 3.3 miles from the northern end and 5 miles from the southern. It is also convenient to coal, as a railroad runs along Fortieth street directly past the building, and a coal siding will be run in along the east side of the power house between it and the structure, as shown in the accompanying plan and end elevation, Figs. 3 and 4. From the coal cars the fuel is shoveled or dumped into the hopper which surrounds the car as shown, and falls into a coal crusher under the coal track. This coal crusher is driven by an ironclad C & C motor. From the crusher it is taken by John A. Mead conveyors and distributed along the coal storage bins under the roof of the boiler room. From the bins and hoppers it is fed down to the mechanical stokers. Between the hoppers and the discharge pipe which delivers fuel to the stokers, is an automatic weighing device furnished by Borden & Selleck, which causes coal to be discharged 224 pounds at a time; the number of discharges being recorded, the coal supplied to any boiler is easily calculated. The mechanical stokers are of the Babcock & Wilcox make, as are also the boilers.

There are eight of these B. & W. boilers, each provided with 64 square feet of grate surface and rated to evaporate 12,000 pounds of water per hour, or 600 h. p. with an engine consumption of 20 pounds per indicated h. p. per hour. These boilers were given a cold water test of 300 pounds per square inch after being set up in the power house. For boiler feeding there are three Blake compound feed pumps, 10 x 7 x 12 inches. The exhaust of these pumps is run through a Warren Webster feed water heater. The feed water supply may be drawn from two sources—from the main engine condenser discharge or from the city water mains. In the water mains from which the station water supply is drawn, two meters are placed, and a water meter is also placed in the supply pipe of each boiler. A double system of feed water piping is installed whereby the feed water heater may be cut in or out and the Green economizers may be cut in or out. These two Green economizers are put over the smoke flue of the boilers and draw the hot gases from a point in the main smoke flue midway in the bank of boilers, and discharge into the stack just above the main flue. When the economizers are to be thrown out of use the economizer flue in the middle of the bank is closed and the smoke discharged direct into the stack. The coal conveyors as well as the economizer scrapers are driven by C & C motors. The ashes are discharged into conveyors in the boiler room basement and lifted to a bin at the top of the boiler room, from whence they can be drawn at convenience.

The stack is a riveted steel plate structure, lined with fire brick. The plates of which it is composed are ½ inch thick at the bottom and grow thinner toward the top, where they finally come down to ¼ inch. The total height of the stack above foundation is 200 feet. The diameter of the steel casing at the bottom is 19 feet, at the top 13 feet 9 inches. The fire brick lining is 9 inches for the first 57 feet, 8 inches for the next 50 feet, 6 inches for the next 50 feet, and 4½ inches for the last 43 feet.

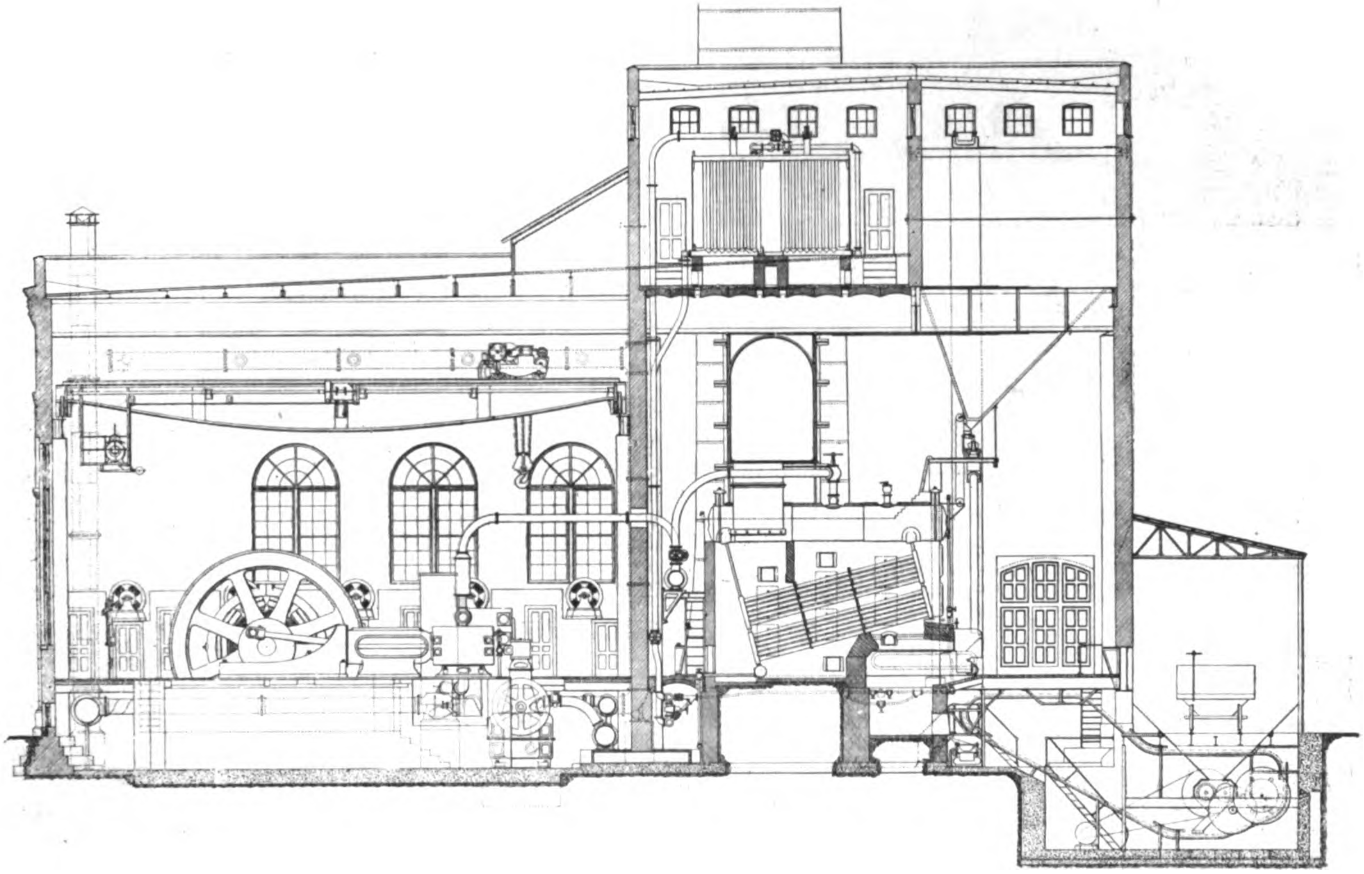


FIG. 4.—TRANSVERSE SECTION OF POWER HOUSE, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

The boilers are piped to the main headers by 8-inch pipes. The main headers are 12-inch, of which there are two, joined at the middle by a 9-inch copper expansion bend in the middle. These headers rest on rollers supported on brackets along the wall separating boiler and engine rooms. The pipes to each of the 1,200 h. p. engines are 8 inch. Copper bends are used throughout. S. J. McLeod was the contractor for the station piping. The engine room shown in Fig. 5 contains four cross compound, horizontal, condensing, Allis Corliss engines, each 26 x 54 x 48 inch stroke. They run 80 revolutions per minute and develop 1,200 horse power at the most economical point of cut-off but will run as high as 2,000 horse power. Each engine is direct connected to an 800 kilowatt Westinghouse generator. Each engine has an independent Reynolds condenser which takes water from the tank at the bottom of the cooling tower and discharges into a 20-inch pipe which runs to the top of the cooling tower. A 30-inch free air exhaust main also

runs the length of the building. This exhaust is made of riveted steel pipe. A plain gravity oiling system is piped to all the machinery. After running through the bearings the oil passes through Turner filters and is pumped back to the tank in the upper part of the station. A Westinghouse air pump supplies compressed air for cleaning out armatures. Air is piped to each generator. A Morgan traveling crane spans the engine

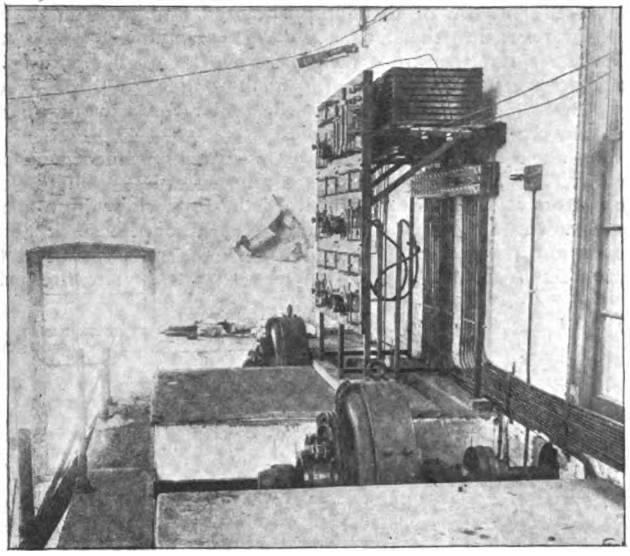


FIG. 7.—SWITCHBOARD AND C & C MOTORS DRIVING FANS FOR COOLING TOWER OF SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

room. It is rated at 60,000 pounds carrying capacity, is 59 feet long and equipped with a General Electric motor.

The dimensions of the power house are 200 by 112 feet. The boiler room is 200 by 48 feet and the engine room 200 by 59 feet. The engine room has capacity for two more units like the four already in and the boiler room will contain enough more boilers to make up for the two engines. The height of the engine room from the floor to the bottom of the roof girders is 34½ feet. There is a 9½ foot basement under the engine room. The roof girders are 4 feet deep.

The switchboard is white marble, equipped with G. E. switches and circuit breakers and Weston ammeters and voltmeters. The four generator panels are 1,500 ampere nominal capacity each and have the usual G. E. equipment of positive and negative quick break switches, ammeter, circuit breaker and field rheostat controller. The terminals of the field rheostats are on the panels but the resistance itself is in the basement. There is a main panel through which the total station output flows and this panel is designed to carry 8,000 amperes. This panel is equipped with an 8,000 ampere ammeter, a recording wattmeter, a Bristol recording voltmeter and two Weston voltmeters, one for contant use, the other to be plugged in at any generator panel before throwing that machine in. The feeder panels each are arranged to take care of two feeders. At the bottom of a panel near the floor are two single pole switches. Just above the switches is a circuit breaker; above this the two ammeters are placed and finally at the top of the panel the other circuit breaker. This arrangement has the advantage of being more compact than the usual arrangement of one feeder to a panel, but it has the disadvantage of bringing the lower circuit breakers uncomfortably near the attendant. One feeder panel of small capacity is devoted to the station motors and lights and has a recording wattmeter.

The power house is in charge of A. L. Hadin, chief engineer, a gentleman of marked ability in this line of work and formerly chief engineer and master mechanic of the Aurora Street Railway.

THE COOLING TOWER.

The greatest interest of course centres around the immense cooling tower, shown in Fig. 6, for supplying cool water to the

FIG. 9.—PORCELAIN INSULATOR USED FOR INSULATING THIRD RAIL, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

condensers, this being the largest electric railway power house ever built to use condensing water not supplied by a natural water supply. The word immense, however, does not exactly apply to the tower that has been built, for considering the horse power it has been designed for it is remarkably compact. It is 16½ feet wide, 64 feet long and 34 feet high. Under the tower proper is a tank 6 feet deep so that the total height of the structure is 40 feet. The tower is constructed under the designs of the Wheeler Condenser & Engineering Company, known as the Barnard system. A 20-inch discharge pipe is run the length of the engine room and all the condensers discharge into it. At the end of the engine room next to the cooling tower this pipe runs vertically up the outside wall to a height of 48 feet which is 12½ feet above the top of the tower.

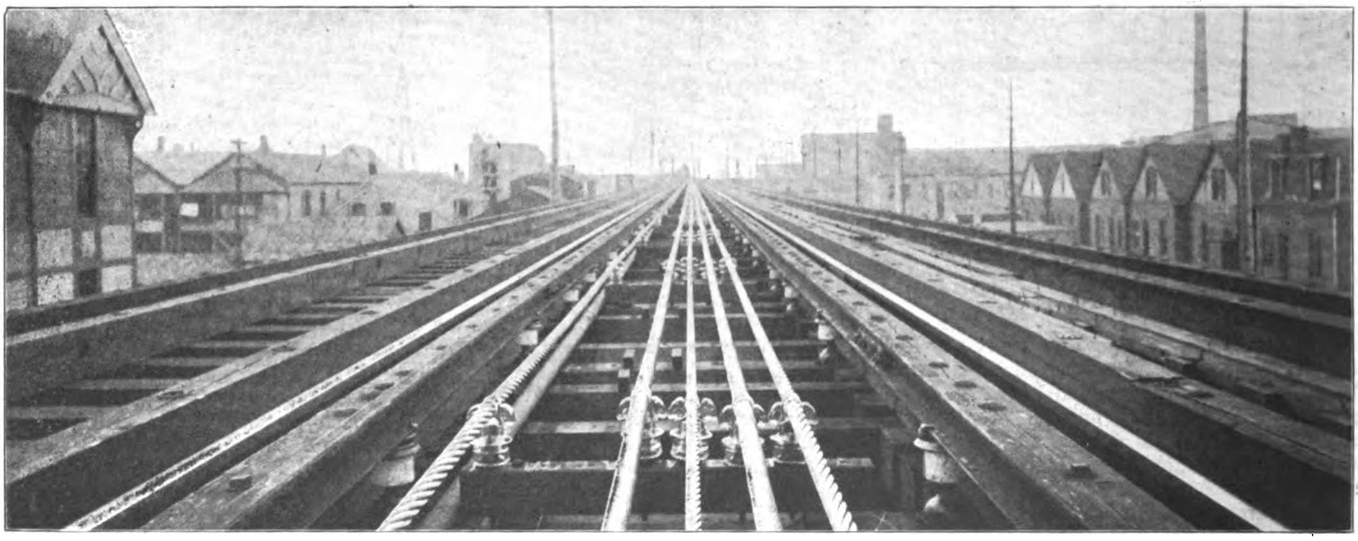


FIG. 8.—TRACK CONSTRUCTION AND LOCATION OF FEEDERS, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

This vertical pipe is left open at the top as an emergency overflow in case the pressure rises above a certain amount in the condenser discharge. At a level with the top of the tower a 20-inch pipe leads off horizontally from the vertical discharge pipe and is supported on brackets on the wall of the power house. From this 20-inch horizontal pipe a 10-inch branch pipe is led over to the tower every 11 feet 8 inches. These

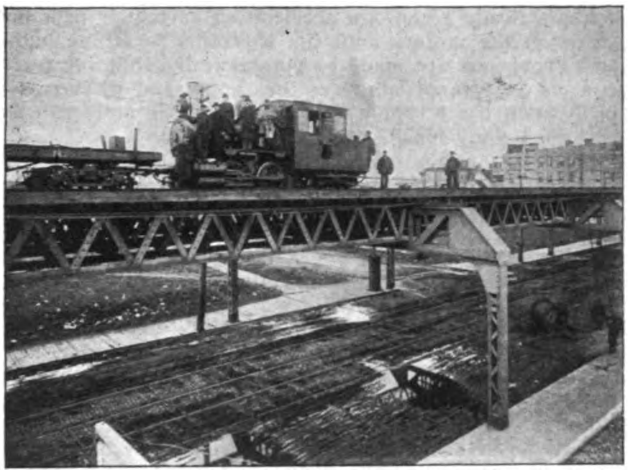


FIG. 10.—METHOD OF HAULING UP FEEDERS BY MEANS OF A STEAM LOCOMOTIVE, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

branch pipes discharge into headers from which the water is sprayed over wire nets which are hung vertically like curtains in the tower. It then trickles down over the wire netting to the tank at the bottom during which process it cools by contact with the air and by evaporation. The tower is built of steel plate and was constructed by the Toblin & Hamler Manufacturing Company which company also made the stack. At the bottom of the tower air can be drawn in by ten 10-foot fans. Two fans are on each shaft, as shown in Fig. 6. The tower adjoins the north end of the engine room and the five fan shafts are run through into the engine room where are five 18 horse power C & C motors, shown in Fig. 7, direct connected to the shafts, and set on a gallery over the toilet rooms. The maximum speed of the fans is 175 rev. per minute. On the motor gallery is a switchboard for the fan motors at which they can be connected in various combinations of series and parallel to give different speeds. It is not expected that all the fans will be necessary except with the station fully loaded in the hottest weather. The rated engine capacity of the plant is 4,800 horse power at present and will ultimately be 7,200.

CURRENT DISTRIBUTION SYSTEM.

The standard Chicago elevated third rail system is of necessity employed to deliver current to trains as this road uses the Union loop in common with the other electric elevated roads. The third rail is located at one side of the track, as will be seen in Fig. 8, just outside the guard rail and the top of the third rail is 11½ inches above the ties. It is a 40-pound T rail in 60 foot lengths and is supported by porcelain insulators, shown in Fig. 9, every 6 feet. Every 2,000 feet the third rail is anchored to the guard rail with strain insulators. This is to prevent creeping of the third rail, especially on grades. The third rail is sectioned about 200 feet from every station so that there are approximately as many third rail sections as there are stations, but these sections are all tapped off a copper main which runs continuously the length of the road and to which all the feeders are connected so that practically the entire feeder system is tied together and the maximum benefit is obtained from the copper used. For protection against short circuits on the third rail a circuit breaker is inserted in the wire which connects a third rail section with a main. This circuit breaker is put in a box near each station where it can be easily reached by trainmen and is of the regular General Electric station type. In the box are also seven pilot lamps which show whether the

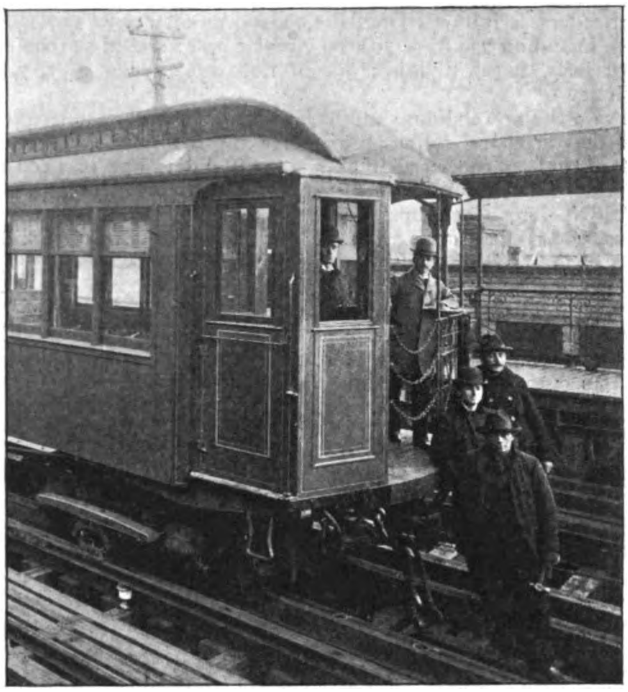


FIG. 11.—SHOWING CONTACT SHOE ON SIDE OF TRUCK AND VESTIBULE FOR MOTORMAN ON CARS OF SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

current is on the section, and a knife switch in series with the circuit breaker. The circuit breakers will be set rather high so that they will not open on any ordinary overload, while at the same time they will open so that a ground will cause no trouble outside of a short section of track. Motormen will be given instructions about closing the circuit breakers along the line and as there will nearly always be a train near a circuit breaker this plan will probably not cause many delays. The car circuit breakers are expected to take care of grounds on car equipments and the line circuit breakers are for the comparatively infrequent track grounds. It has been the policy of the engineers all through in laying out the third rail system to provide for cutting out of short sections of track and confining

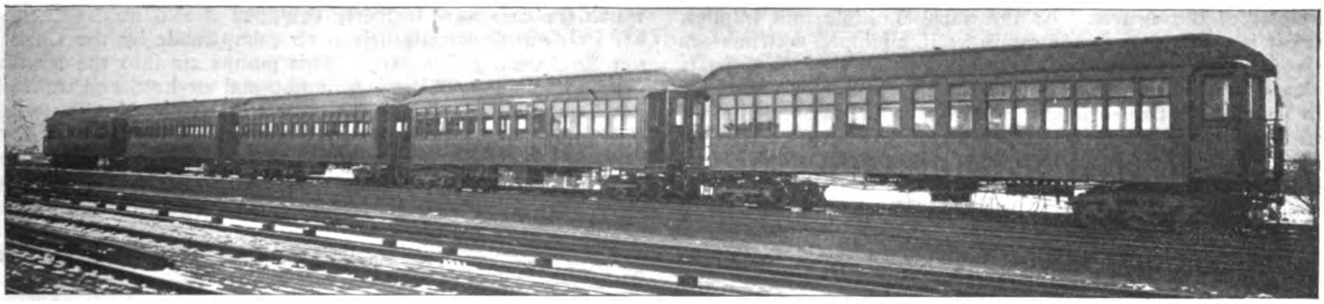


FIG. 12.—A MULTIPLE UNIT TRAIN OF FIVE CARS, SOUTH SIDE ELEVATED RAILROAD, CHICAGO.

troubles to a small part of the road. In the yards a knife switch is provided for cutting out each siding so that the third rail can be killed when current is not needed on a siding or when repair men are working around trucks. The circuit breakers along the main line afford like facilities to workmen along the main track during quiet hours.

The third rail is double bonded at each joint with Atkinson No. 0000 bonds. The track rails are bonded with the Roebling Columbia bond No. 0000. The two rails of a track are cross bonded every 120 feet and the two tracks are cross bonded and bonded to the structure every 500 feet. A riveted terminal is employed for this latter purpose.

The feeders are bare copper cable and are run in a box between the tracks supported on centre bearing glass insulators with iron pins covered with wood and wood cross arms. From the power house north, feeding 3.3 miles of double track, there are feeders as follows: One of 1,000,000 circular mils cross section, including 730 ft. of 500,000 circular mils; one of 500,000 circular mils, 16,327 ft. long; one of 1,000,000 circular mils, 7,461 ft. long.

From the power house south, feeding 5 miles of double tracks and the yards and siding, the feeders are as follows:

One of 1,000,000 circular mils 5,890 ft. long; one of 1,000,000 circular mils 10,462 ft. long; one of 1,500,000 circular mils 16,048 ft. long (including 986 ft. of 500,000 circ. mils); one of 1,500,000 circular mils 22,822 ft. long; one of 500,000 circular mils 23,122 ft. long.

The present feeder system is calculated for 120 cars. At each crossover the feeders go under the structure. In laying the feeders the Electrical Installation Company made use of a steam locomotive. The cables were drawn from a reel under the structure and the locomotive proved an invaluable adjunct in drawing through the feeders in unbroken lengths; this operation is shown in Fig. 10.

It will be seen from the description that standard line material was made use of very largely so that the cost was reduced much below what it would be if special insulators, etc., had been used.

The voltage used is 600 to 650.

In the yards at 63d street is some special work of such complicated nature that it was impossible to secure a continuous contact between the shoes and the third rail. This together with the impossibility of safely having a third rail in the shops led to the equipment of all the cars with an ingenious little rubbing contact overhead trolley. A trolley wire has been strung over the special work in the yards and in the shops. The trolley is the design of B. J. Jones of Sargent & Lundy's staff. It consists of an arch of brass rod held in balanced tension by springs at each end so that it normally stands vertical but can be deflected either way. This trolley is only 14½ inches high and the trolley wire is hung but a short distance above the car roof. When a car runs under the trolley wire this trolley yields one way or the other to the wire and no attention is required by the trainmen.

CAR EQUIPMENT AND MULTIPLE UNIT SYSTEM.

The Sprague multiple unit system which is being employed on this road has been so much discussed lately that it is hardly necessary here to give more than a brief statement as to the principles of the system. As the name multiple unit implies, each car is a complete motor car in itself, equipped with motors and controlling apparatus. The great ingenuity of the plan is displayed by the arrangements whereby the motors on the whole train may be controlled from any point on the train. The apparatus to safely accomplish this is somewhat complicated and as yet Mr. Sprague has authorized no publication of the many details and whatever articles have appeared purporting to give details have been far from correct. The general principles, however, are as follows: The motors under each car are controlled by an ordinary street car controller located under one hood of the car. This controller instead of being operated directly by a manual lever is connected to a small pilot motor. To operate a car the motorman simply controls the pilot motor circuit. In fact the whole system of train control simmers down to this one problem of properly controlling these pilot motors which work the controllers on the various cars. On each platform of every car is a small controlling box whereby the motorman controls the pilot motor circuits of the various cars. The cars are connected electrically by plug couplings. It makes no difference how many cars are in a train the motors all act in synchronism or approximately so. The rate of acceleration of a train is not governed by the motorman, but automatically. An automatic throttle governs the pilot motor in such a way that the pilot motor can advance the controller from one notch to the next higher only when the current flowing through the armature of one of the motors under cars falls below the amount for which the throttle is set. For example, if the throttle is set for 100 amperes the pilot motor will move the controller ahead a notch every time the current falls below 100 amperes so that practically a constant accelerating current is kept flowing through the motors until the controller is at the highest point. Provisions are made to automatically shut off current from a car in case of failure of the supply and to turn it on again by steps if the supply is resumed and the motorman still has his controlling handle on.

A great deal of argument might be indulged in as to the merits and demerits of the system, but time and experience will settle the question better than any amount of argument. As to the efficiency and cost of maintenance of the multiple unit system for performing a given service as compared with the performance of the same service by a locomotive or motor car at the head of the train there will naturally be considerable difference of opnion. One thing, however, must be admitted by all, namely, that it affords a traction on the drivers by distributing the motors through the train which can be obtained in no other way at present on an elevated road where the weight of locomotives is limited by the strength of the structure. This gives two advantages either or both of which may be made use of. It gives a traction on the rails which permits a faster acceleration and consequently faster schedule than can be obtained in any other way provided motors of sufficient capacity are provided; or it permits the running of longer trains than any locomotive could haul. Either one of these items may mean the attraction of enough traffic to offset any increase in operating expenses which the multiple unit system may involve. Faster schedule time means the attraction of passengers to the road and longer trains mean the ability to comfortably carry more passengers per hour if trains are already operating on the shortest permissible headway.

Just what the schedule time on the South Side Elevated will be it is of course impossible to say until the road is in full operation electrically. The guaranteed schedule of the new electrical equipment is 15 miles per hour, which is but slightly above the present steam schedule. The results will be watched with much interest.

In changing the rolling stock from steam to electrical equipment the old truck was taken from under one end of each car and a McGuire elevated motor truck substituted for it. On this motor truck two G. E. 57 motors of 50 horse power were mounted. Thus half the weight of the car body and the weight of the two motors is on the driving wheels or about 60 per cent. of the total weight. Contact shoes are mounted on each side of each truck. It was necessary also to have a vestibue for protecting the motorman on the front platform, shown in Fig. 11. A folding vestibule was designed, the two sides of which swing back against the end of the car out of the way of gate or passengers when the vestibule is not in use. Up against the front wall of the vestibule are the air brake valve, air pressure gauge and electric trolley handle. The Westinghouse air brake with which the cars were formerly equipped is still used. Each car has its own electrically driven air pump made by the Christinsen Engineering Company. This pumps air into the auxiliary reservoir under each car. An additional air hose and train pipe has been put in in addition to the regular Westinghouse train pipe for the purpose of connecting together the auxiliary reservoirs and equalizing the reservoir pressure throughout the train.

The Gold electric car heaters are used and are hung under the seats. When giving their maximum effect they take 22 amperes per car at 600 volts.

The maximum speed of the motor equipment on these cars is about 26 miles per hour.

There are 120 cars equipped with motors and 30 more cars which have been wired for electric lights, heaters and pilot motor circuits, but are without motors. These can be run in among motor cars of multiple unit trains. A multiple unit train of five cars is shown in Fig. 12.

The change of the cars from steam to electric equipment involved much more work than is apparent at first thought. It had to be accomplished without interfering with the steam service. Five coaches at a time were taken to the Wells & French

car shops where they were fitted with vestibules and at the same time the Electrical Installation Company mounted the new motors and trucks and did part of the car wiring. All of the wiring could not be finished, however, because of the presence of the steam heating and Pintsch gas lighting systems. After the road is in full electrical operation the work will be finished by removing the steam heat and Pintsch gas apparatus.

The first electric service on the road was begun with seven 3-car trains April 20, 1898. The electric trains will be put on a few at a time until the complete change from steam to electric service has been accomplished.

ELECTRIC LIGHTING

Electric Light and Power Station Records.

THE difficulty of keeping reliable records of the daily operations and output of electric light and power stations is familiar to every station superintendent. The usual method of taking readings of the different instruments at regular intervals and entering them into a log book from which curves are traced on the following day is unsatisfactory, for several reasons. With this method the amount of clerical work necessary to be done in order to produce curves that are sufficiently accurate to be of any practical value is so great that in the large majority of stations no attempt is made to keep such records.

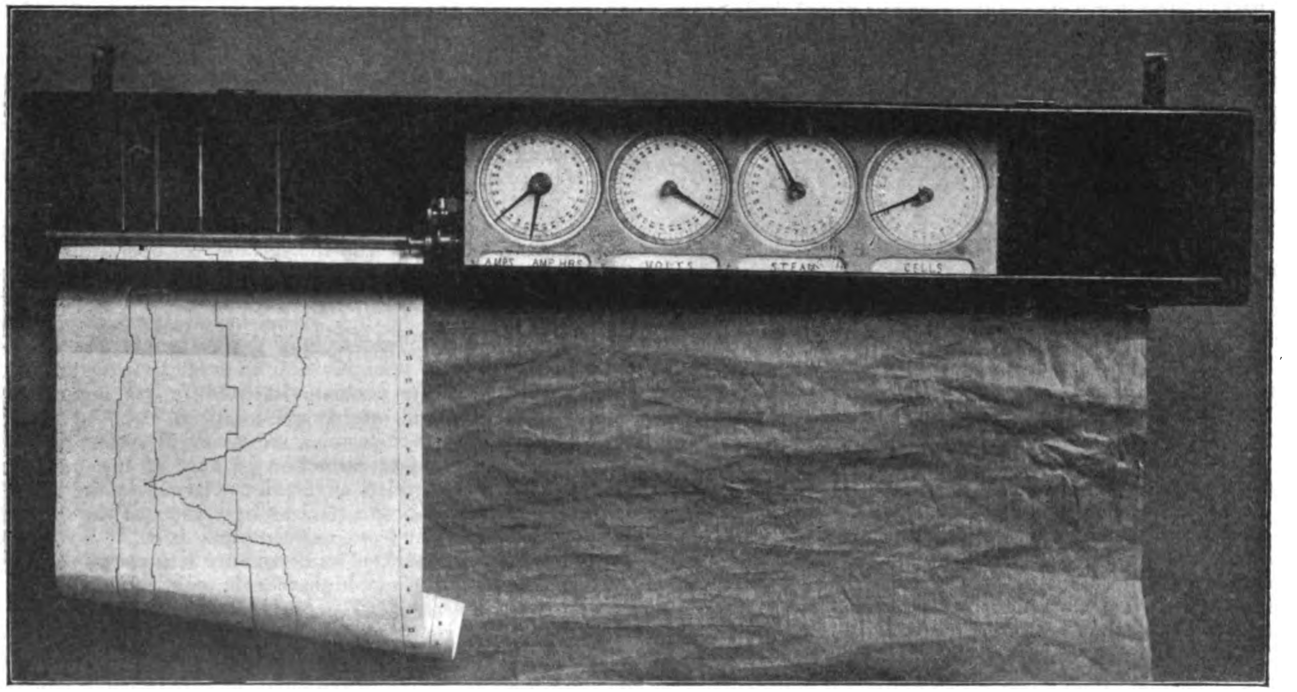
It is easy to understand why no great degree of accuracy can be expected from records kept in this manner, when it is considered that usually three or four persons are responsible for the figures representing one day's operations, and that the services of still another person are required to plot the curves from these figures. The fact, also, that a switchboard operator seldom has much experience in the duties of an accountant, and that he is obliged to use writing material one moment and an oil can or similar piece of apparatus the next, readily explains why these records frequently cannot be deciphered even by those who have written them.

The importance, however, or rather the necessity, of having trustworthy curves to show how the conditions in an electric light or power house vary from hour to hour, is so obvious that it is hardly necessary to dwell upon it. Without such curves it is impossible to have any definite idea of where losses occur or in what direction improvements should be made in the operation of the plant.

In stations where storage batteries are used it is absolutely necessary to keep accurate records if losses in current and injury to the battery are to be avoided. In such stations the switchboard operator should have constantly before him something to show what work the battery has just been doing, in order that he may be able to give the battery proper attention and make use of it to the best advantage. For this purpose curves traced in the usual manner are obviously of no service, as the occasion for which they are needed arrives before the curves are made out.

When one switchboard operator relieves another he should have the means of becoming thoroughly acquainted with all the conditions existing up to and at the time that he comes on duty. This is necessary in order that he may know what has to be attended to. To furnish this information, the records should be complete up to the time that he takes charge, and arranged in such manner that a person familiar with the work can understand the whole situation at a glance. This latter point is important, because a switchboard operator usually has so much to attend to that he cannot devote much of his time to finding out what has been done by those who were on duty before him.

The apparatus represented in the accompanying figure was designed for the purpose of diminishing, to some extent, the amount of bookkeeping necessary to be done in connection with station records. The method of operating the instrument is somewhat similar to that of operating a cash register. Its construction can be readily understood by reference to the cut. The sheet of paper on which the records are to be made is drawn forward between two rollers by means of a small lever and ratchet on the end of one of the rollers. A number of pencils, corresponding to the number of curves desired, press against the paper and trace the curves as the paper is drawn forward.



MACRAE'S APPARATUS FOR KEEPING ELECTRIC LIGHT AND POWER STATION RECORDS.

Each pencil can be set in any position relatively to the width of the paper by means of a gear wheel engaging into a rack fixed to a tube on which the pencil is mounted. The shaft on which this gear is fixed is provided at one end with a pointer, which moves over a divided scale, and at the other end with a small hand wheel, by which the pointer and the pencil connected with it can be set in different positions. These hand wheels are not seen in the figure, as they are on the ends of the shafts, which pass through the bottom of the case.

Each time the readings of the different station instruments are to be recorded the dial indexes connected with the pencils are set to the points corresponding to these readings. The lever operating the paper is then drawn back against a stop and released. This forces the paper forward a definite amount and

each pencil adds a corresponding amount to the curve that it is tracing. A type wheel attached to one of the rollers prints at the same time the hour of the day on the margin of the paper. When, as in the case of ampere hours, a time dimension enters into the quantity of which a record is to be made, the dial is provided with two index hands mounted on one shaft, in the same manner as the hands on a clock dial. One of these indexes, which we may call index No. 1, is fixed on the shaft and marks the position of the pencil which traces the curve. The other, or No. 2 index, is connected to index No. 1 by means of a clutch in such a way that when index No. 1 is moved forward it brings No. 2 index along with it, but when index No. 1 is turned in the opposite direction the clutch is released and index No. 2 does not move.

Each time that No. 1 index is to be set for a reading, it is first moved back to zero and then brought to the position in which it is to remain until the next reading is taken. By this operation No. 2 index is made to integrate the curve traced by the pencil connected to index No. 1; for example, if the pencil is tracing an ampere curve the reading of No. 2 index will be the number of ampere hours represented by that curve. In order that the reading of No. 2 index may represent ampere hours directly, the relative rates at which the indexes move over the dial must be determined by the number of readings taken per hour; for instance, if five minute readings are taken No. 1 index should pass over 12 scale divisions while No. 2 index is passing over one division. If, however, there is occasion to take readings of any other frequency, without altering the ratio of the gears connecting the two indexes, a reducing factor must be employed in connection with the dial indications.

The part of the paper containing the curves of one day's operations can be cut off and filed away in the regular manner, or the paper may be wound on another cylinder until the whole roll is used up.

Statistics on English Electric Lighting Plants—III.

(Concluded.)

BY CLAUD P. D'OYLY.

THE incorporated companies are in many cases close corporations, and as in the case of the companies over here, do not offer to sell stock, and it is consequently hard to get an idea of the value of the same; but of eighteen companies which are quoted in the financial papers, organized to furnish light and power, the common stock is worth par on a basis of dividends of 3.3 per cent.; that is to say, stock of a company which pays 6.6 per cent. is worth 200.

In many cases the value of stock never comes to be considered at all unless it be at a time when the corporation makes an attempt to buy the plant or in the settlement of an estate or in an attempt to buy out the "founders' share." A recent case of the latter is the Metropolitan Electric Supply Company, which is paying regular dividends on the different classes of stock, and is likely soon to have a surplus to pay to the holders of founders' shares.

It might be mentioned incidentally that in the organization of the company, the subscribers to the preliminary expenses received founders' shares on which no dividend is to be paid until all the other shares are on a certain dividend basis—in this case 7 per cent.—when the surplus to be divided up goes one-half to the ordinary stockholders or surplus fund, and the other half to the holders of founders' shares.

The Metropolitan Electric Supply Co. offers to holders of founders' shares for each share 140 shares of common stock, paying 6 per cent per annum. The holders want 300 times the amount held in new stock, and as the stock is worth 220, par 100, they would be getting 660 times their original investment. The company offers 308 times the original investment to obtain these founders' shares (100 shares, par $50). Two other London companies had to buy out their founders' shares at a cost of $600,000 for one company and $750,000 for the other.

Engineers are constantly on the alert for improvements looking to a gain of efficiency in the different parts of the system. The money necessary is a very secondary consideration, and consequently manufacturers in England make a very high efficiency machine—a great deal higher than is ordinarily made on the Continent of Europe or as standard machines in the United States. Many of the manufacturers make 80 k. w. generators, of which they guarantee the efficiency to be upwards of 95 per cent. This makes the machines heavy, and they do not look symmetrical, and they require movement of the brushes with the variations of load, a point which would instantly condemn them in America. English manufacturers have not made many 550-volt generators of any considerable size, and consequently have not had any experience with "bucking." When they have experienced this, they may aim at machines with a larger air gap and a lower efficiency, more after American practice, but which machines will take care of themselves. In the general run of specification, great stress is laid on the efficiency at different loads, and the $\frac{\text{E. H. P.}}{\text{I. H. P.}}$ is a point on which great stress is laid by the consulting engineer by whom the plant is to be accepted; and the amount of attention required at the switchboard and brush-holder is of small importance. This is the natural result of having cheap assistants to look after the details in the station. The average mechanic or laborer in England gets about one-half the pay he would get by crossing the Atlantic; but the man who has had a technical education, and who has a good knowledge of construction work and keeping the plant in operation would probably receive four times as much pay on this side of the Atlantic. A good fireman would receive very little more for skill in working on his fire than a day laborer, although no one has a better opportunity to save money.

A machine which is having a good run just now is the "rectifier," which takes alternating constant potential current and transforms it into approximately direct constant current. These machines are very sensitive and require rather delicate adjustment, but they show an efficiency of 89 per cent. at one-quarter load, and run up to 96 per cent. at full load. When you compare this with the constant current arc generator with an efficiency of 65 per cent., it is quite a contrast. Besides the gain of efficiency in the rectifier itself, there is the gain of efficiency caused by increasing the load on the alternator. A good many plants are also using, at present in a rather small way, cut-outs for transformers, to save the iron loss during the hours of light load. For any one who has noticed the loads on alternating stations in hours of broad daylight, this matter has much interest, but no one seems to have solved the matter in a really practical way, as the tendency of the insulation to break down is one point of great difficulty, and the size of the apparatus must be moderate, and the certainty of operation, especially in the matter of cutting in the transformers, must be absolute, and the mechanism should not require any more inspection, especially if it is to be put in out-of-the-way places in transformer vaults or on poles, than a transformer or fuse block. It has been mostly scientific and theoretical investigators who have worked on the problem—it has not yet come into the hands of the practical mechanical engineer.

All these different economies and the rigid system of accounts has enabled a constant reduction of cost of the k. w. h., so as to lead to a reduction of the sum charged to the customers. Some of the metropolitan stations have reduced the cost of distributing the current from ten cents per k. w. h. to four cents in five years; but much of the economy is through the increase of customers, bringing higher economy of machinery and smaller fixed charges per k. w. sold. This has in most cases been done in economy outside of the coal pile, as the climate exercises a bad effect on the variations of the load and alternating plants having no storage batteries suffer the most. Metropolitan stations must always be prepared for fogs, which drop down without any warning and instantly cause the load to be multiplied by 10—and in alternating plants this means having many boilers fired up ready for an emergency of this kind. Other cities have climatic changes which demand about the same coal expenditure, but not in the same degree. Coal is an item which is not very easy to save, providing the management is efficient, and it is the poorest thing in which to make comparisons. The price varies between $2 and $5 per ton, depending a good deal on the distance from the coal mines and the calorific value of the coal. The best results obtained in any plants in England in the amount of coal consumed per k. w. h. sold is 6.2 lbs., and there are several companies which come near this mark, of very widely varying outputs. The largest in the matter of outputs is the Westminster Company, which sold 3,600,000 units in 1897. The second is the St. James station, which furnished 2,500,000 units at the same expenditure of coal per unit. At about the same coal consumption per k. w. h., but furnishing only 514,000 units, the Oxford Company stands well. Kensington and Brighton stand about the same as regards fuel consumption per k. w. h. sold, 6.25 lbs.

Kingston-on-Thames uses 25 lbs. of coal, but of very poor quality, per k. w. h.; and it costs 3.24 cents per k. w. h. The total k. w. h. sold was less than 200,000.

In Scarborough, another town which sold only 200,000 k. w. h., the cost for coal was 2.58 cents.

It is strange how Oxford, selling 500,000 units, can generate the current with 6.25 lbs. of coal per k. w. h., and no other companies can beat it, although you would look for some one of the companies outside of the metropolitan area of fogs to do it.

The electric lighting art has not been developed to the same extent in England as it has in the United States, and although they are making some headway now and are doing it in a thoroughly systematic way, it will be a long while before they can catch up with us, as after all the larger towns are lighted up, then the question comes up which was tackled here years ago, of the small towns which are too small for gas works, and which were equipped with overhead wires in America, but which cannot be done in England unless new Board of Trade regulations are passed.

TABLE IV.

Works.	Cost in cents per unit.	Units sold.
Bradford	2.06	820,000
Brighton	2.88	1,400,000
Edinburgh	1.26	1,700,000
Glasgow	2.64	1,600,000
Leeds	1.60	800,000
Liverpool	2.28	850,000
Manchester	1.88	2,800,000
Portsmouth	3.25	620,000

Table IV. gives the cost of fuel, oil, labor and repairs and maintenance expenses, as works cost, and it shows the variation in different plants with somewhat similar output. These are all very low, but all vary in conditions as regards system of distribution, kind of engines and generators, boilers, etc., although some manufacturers claim low works cost through using their particular kind of apparatus. The increase of the plants is the strong feature which has brought up the high efficiencies.

Protection for Edison Three-Wire and Other Balanced Systems of Electrical Distribution.

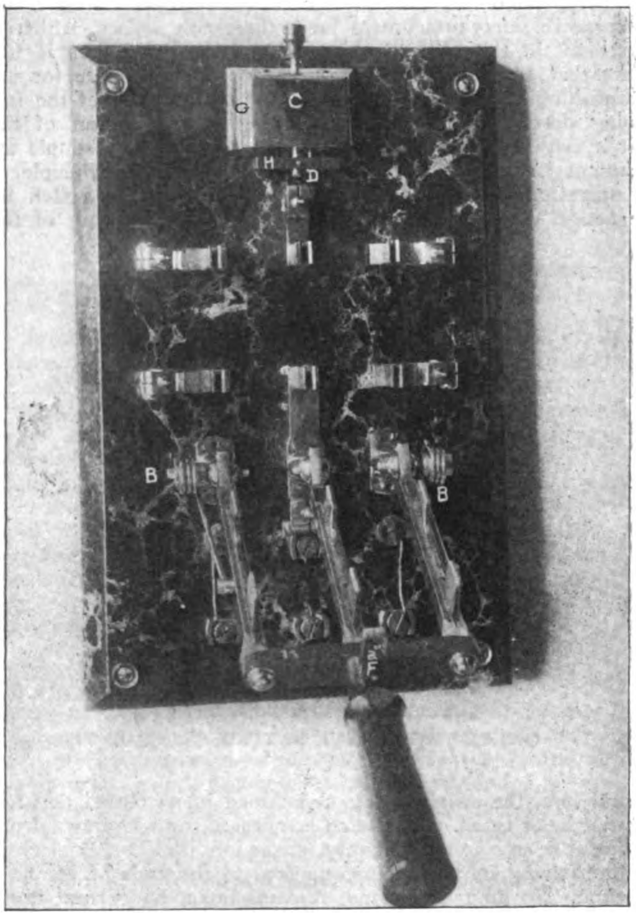
BY EUSTACE OXLEY.

It is well known to electrical engineers that the blowing of the fuse on the neutral wire of an Edison three-wire system is often the cause of disastrous results to the lamps, and to the wiring, as well as to other translating devices that may be connected. These results are due to the sudden and considerable increase in potential upon that side of the system having the smaller load, such increase being produced by opening the neutral, or balancing wire, by the blowing of its fuse. The increase in potential from this cause, upon a three-wire system, may reach a point where it is almost double the voltage that should normally exist, and such a rise is not unusual. Evidently, incandescent lamps, as well as motors and other apparatus constructed to operate under a pressure of only 110 volts, and which are suddenly subjected to nearly twice that potential, are unable to resist a strain that they were never intended to undergo. It is not surprising, therefore, that their complete destruction, or serious injury, should be the unavoidable result.

Under such circumstances, the blowing of the neutral fuse is usually followed by a rapid increase in the illuminating power of the incandescent lamps upon the under-loaded side of the system with a corresponding loss in those lamps on the other side that are in circuit at the time, and then by the bursting of the former, their rupture being accompanied by a loud report, and the scattering of shattered glass. These results, which speedily follow the blowing of the fuse, are of such nature as to produce an extremely startling effect upon those who happen to be present at the time of such an occurrence; while in the minds of those who, from ignorance, fail to comprehend the nature and cause of these disturbances, it is not strange that they should produce a strong and permanent prejudice against the use of electric energy.

So far as the injury to the system is considered, the lamps, even if they escape complete destruction, are so severely strained by the abnormally high potential to which they are exposed and the excessive current forced through them, that their candle-power, as well as their term of use, are largely diminished, and the injury is usually so serious that their immediate removal and the substitution of new lamps is expedient. The damage to the incandescent lamps may represent, by itself, a considerable expense to a generating company, upon which these losses fall. When fan-motors, or enclosed arc lamps, or both, as is frequently the case, form part of the translating devices, the figures representing the financial injury will often be largely increased, and in the latter class of cases the loss will fall upon the consumer instead of the distributing company.

Not long since a disturbance of this character occurred in a large Government building in Washington, the neutral fuse at the main service block blowing at a time when the number of lamps on one side of the system was considerably in excess of those upon the other side. The latter were subjected to a large increase in potential, which was not, however, so high as



OXLEY PROTECTIVE SWITCH, OPEN.

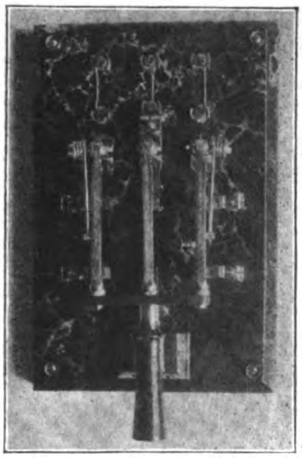
to burst the bulbs. They burned a few moments with a great increase of illuminating power, after which the filaments gave way and the lamps burned out.

Another instance occurred, not far from the same date, in the Bureau of Engraving and Printing in the same city, where about thirty-four enclosed arc lamps are installed on the Edison three-wire system, and supplied with current from the street mains. At the moment when the neutral fuse gave way, eighteen of these lamps were burning on one side of the system, and six on the other side. These six lamps were burned out, and their removal for repairs was the cause of serious inconvenience to the Bureau, as they happened to be located in the printing division, where the work was heavy and in arrears. Many other instances, in private as well as in public buildings, could easily be named. Central station men cannot fail to be aware of their frequent occurrence, and of the annoyance and damage that are the direct results. The over-fusing of the neutral wire, which has come to be a common practice among wiremen and others, came into existence, and owes its prevalence to the fact that it has been, heretofore, the only

known expedient for avoiding disturbances of this character. This practice of over-fusing the neutral is directly contrary to the rules of the Board of Fire Underwriters, but it is probably much more common than is generally known. If the fusing of the neutral wire corresponded, in all cases, with the requirements, the occurrences described would doubtless be greatly multiplied in frequency.

There is a far more serious menace to property, however, in the fact that the abnormal tension on the underloaded side of the system, upon the blowing of the neutral fuse, develops weak spots in the wiring, or if such places already exist, the insulation quickly gives way, under the strain, and destructive fires may be the direct result. Combustible material, favorably located, is all that is required to begin a conflagration, the results of which may be widespread.

To remove the possibility of such disturbances occurring, and the dangers that may, and undoubtedly do, follow therefrom, as well as to eradicate the pernicious practice of over-fusing the neutral, by removing entirely the causes which have led to and perpetuated this evil, the writer has devised a simple and inexpensive safety-attachment for a three-pole switch, which is illustrated in the accompanying cuts. As the writer is not aware that any means have been proposed heretofore for accomplishing these important results, it is thought that the following description of the construction and operation of the switch may be of interest. The device consists of a simple attachment for an ordinary, three-pole switch. The principle of its operation consists in automatically opening the switch by the action of a spring, immediately upon the blowing of the



OXLEY PROTECTIVE SWITCH, CLOSED.

neutral fuse, the switch being maintained in its closed position by a latch, or catch. This latch is released, or withdrawn from its locking engagement, by the attraction of a small electro-magnet having its terminals connected to the ends of the neutral fuse. So long as the fuse remains intact no current flows through the windings of the magnet, as the potential at its terminals is only that due to the drop in voltage in the neutral fuse itself. Upon the blowing of the fuse, however, the potential between the points of connection immediately rises, causing current to flow through the magnet coils, thus energizing the magnet sufficiently to enable it to release the latch. Although the winding of the magnet is in multiple with the neutral fuse, it does not in any degree affect the carrying capacity of the latter, since the resistance of the coils is so great relatively to that of the fuse, as to prevent the flow of current in said coils as long as the integrity of the fuse is maintained.

The switch illustrated in the cuts is normally opened by the springs B, and is locked in its closed position by a latch, or catch C, which consists of a small pin D, which is movable longitudinally. Its end engages a recess A in a hanger F, on the handle of the switch, and is thrown into this engagement by a light spring, coiled on the pin D. The end of the hanger F is beveled to retract the pin as the switch is closed.

The magnet releasing the latch is placed in a strong brass housing, or box, G, by which it is wholly enclosed and concealed, the pole pieces only projecting through one wall. Upon the pin D, which lies between the cores, is mounted an armature H. When the neutral fuse blows, the armature, which is suddenly attracted, releases the latch, thus allowing the switch to be opened by the springs B.

This automatic opening of the switch is so nearly coincident with the blowing of the neutral fuse that a secure protection is afforded against all possible injury to the wiring, lamps, or other translating devices, and every chance of fire being caused by such an occurrence is very completely prevented. The ends of the winding of the electro-magnet are carried in channels upon the back of the switch-base to a point where they can be connected to the terminals of the neutral fuse. The switch when closed is retained in that position by the latch-pin D. It may be instantly released, however, by simply drawing the latch-pin with the finger, when the springs throw the switch open with a movement exceedingly rapid. The parts are all restored to normal position again by simply closing the switch until the latch-pin can enter its locking recess. The opening of the switch follows so closely upon the blowing of the fuse that it is practically impossible to distinguish the interval which separates the two occurrences.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work—VIII.

BY A. E. DOBBS.

IN turning corners, two poles should be used and placed close together, and in such a position as to break the angle as much as possible. Fig. 26 shows how this is commonly done. The use of double arms on the corners is to be commended, as it relieves the strain on the corner pins, and to a great extent on the pole itself, by distributing the pressure more equally.

In the illustration the arms are shown faced in line with the apex of the angle instead of at right angles to the street. This does not seem to be a matter of much importance, but a practical experience has shown that this is the best way, as the strain is against the arm in the line of greatest resistance, therefore

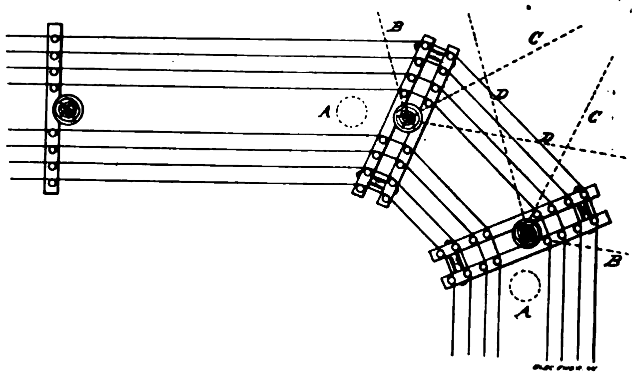


FIG. 26.

relieving the tendency to warp. It also turns the corner on two pins instead of one, as would be the case if square with the street. It may be objected that the wires, as they approach the corner pole, are thrown closer together. Well, the difference will not be much, but it can be avoided by the use of a longer arm. Suppose that the arm shown at the left in Fig. 26 is the ordinary 8-foot 6-inch short arm; by simply using 10-foot arms the lines will be kept at the same distance on the angle as on the straight line. It will not be a great deal of trouble to carry a few long arms in stock for this purpose.

CORNER AND JUNCTION POLES.

Fig. 27 shows the details of a double arm used at a cable or terminal pole. As wires from such a pole are liable to break off in at least two directions, double grooved glass, or better still, the heavy transposition glass should be used.

A, cross section of pole; B. B., arms; b, 5/8 bolt of the required length; c, block to keep the arms at their proper place—gas pipe is sometimes used for this purpose, in which case use a large washer under its ends to keep from cutting into the arm. Again

there are places where a single 5/8 bolt will not hold the centre, but that can be varied to suit the circumstances.

Another device is that shown in the second figu-e, which sometimes takes the place of the block, c. It is simply a bolt with long threads at the ends. A large nut inside the arm allows of any desired adjustment, while the nuts on the outside clamp the arms firmly in place.

t t′ t″ (both figures) shows method of lashing pins together. Make a loop, t, with No. 12 wire, then twist together as in t′ t″. This will hold the pins firmly in place against the pull of the wires.

Some men, however, prefer the figure 8 style, as shown in the first figure, g. g. The ends are passed around both insulators in the form shown, but it does not make so neat a job as the other.

What is known to linemen as buck arms, at junction poles, are not desirable, but sometimes necessary.

The form shown in Fig. 28, however, should always be

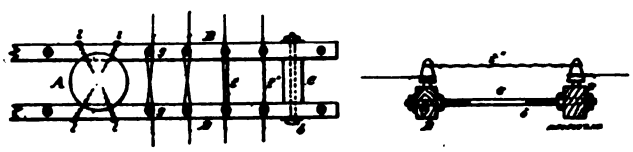
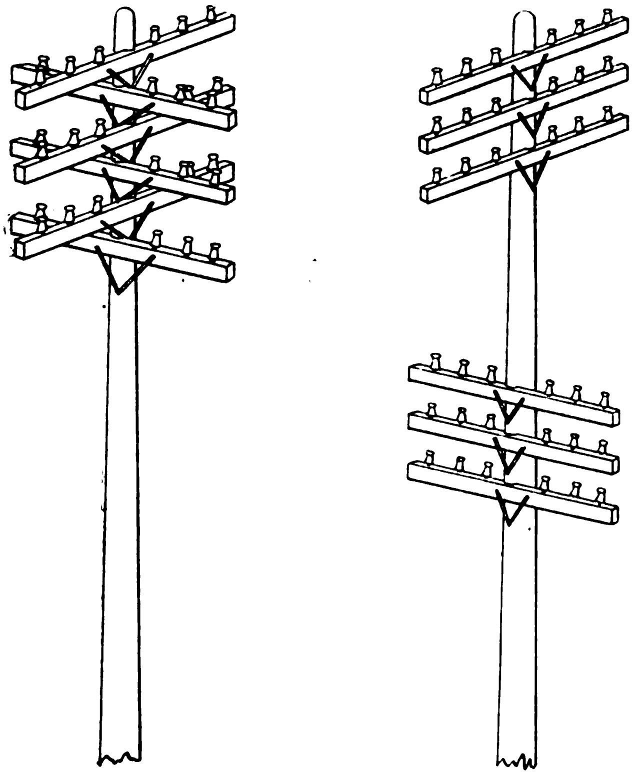


FIG. 27.

avoided, as the wires cross each other like sticks in a crow's nest, making it impossible for men to get through and do any work, without making trouble. A much better plan is that of Fig. 29, provided room enough is left for more arms on the top section. This should be done even if it is thought that there will be no more arms up there, for this telephone business has a way of growing like Jack's beanstalk, and new companies should always expect about four times as many wires as they start in with, and it is always well to have room enough. Good work does not cost a great deal more than the other kind, and is much cheaper to maintain.

Still there are cases where it is necessary to have the buck



FIGS. 28 AND 29.

arms as high as the others. The use of a cable would avoid their use altogether, but this cannot always be done. In the side elevation as shown, Fig. 30, iron or steel strips, S S, are used to hold the arms rigidly in place and afford mutual support. These strips are 1½ by 3/8, and are long enough to reach all the arms. As these arms will be doubled, two strips on each end, or four in all, will be needed. They should all be bored exactly alike, and clamped together with bolts reaching through the arms and blocks. The buck arms, B B, are put out between the third and fourth pins, and bolted down to the others. In order to afford them support, strips should be run from near the ends and bolted back to the pole with a short lag. These strips may be iron, 1 inch by 3-16 inch, or they may be rods, or even two No. 6 wires twisted together. Whether strips, rods or wires are used, they should be raised high enough to clear the wires on the lower arm. It goes without saying that double groove glass should be used on the main arm, and the wires pull

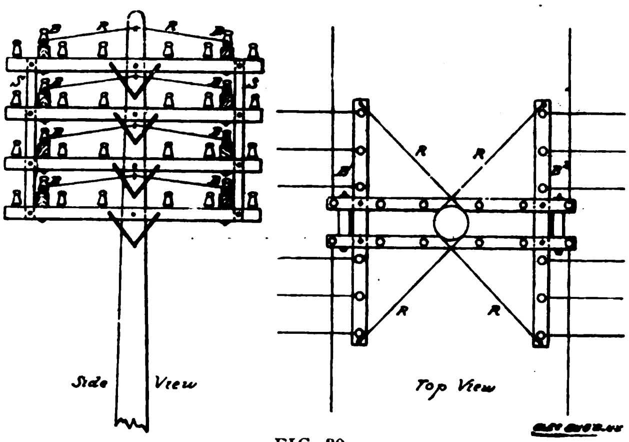


FIG. 30.

off from the lower groove, while the tops are lashed together. If necessary for wires to cross from one buck arm to another, use insulated wire and pass through the double arms from one to the other. A junction pole rigged up in this manner will always leave room enough for the men to work around it and keep the wires clear much better.

In Fig. 31 are shown methods of bracing arms on curves when double arms are not used. The lower figure shows the use of ordinary braces bolted to the arm and united at the pole by a single lag screw or bolt, the same lag going through the large hole of both. That shown in the upper figure may be of strap iron or No. 8 wire passed around the end of the arm and neatly twisted together.

GUYS.

In Fig. 26 it will be noticed that there are several dotted lines running in different directions, to indicate the possible position of different guys. As the wire turns a corner the natural tendency of the pole is to slip back towards the centre of the longest span, and if left free to move longitudinally, that is where it would go, but as it is fastened at the ground it cannot move back more than four or five feet, which would be about the spots marked, A A, provided that the only guys were the side guys indicated by the dotted lines, B B. Therefore, if the line

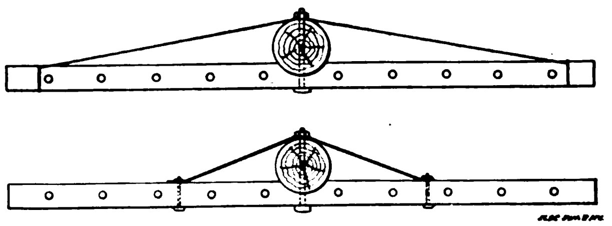


FIG. 31.

must be side guyed in this direction, it will be necessary to put on other head guys, in the direction of D. D. If, however, a stub can be so placed as to pull off in the direction C C, no other guys are needed, as this answers to both head and side guys. If the poles are close together, one stub will sometimes be sufficient for both Remember that these stubs should be well anchored.

SCRANTON, MISS., is installing a 75 h. p. Ball engine, built by the Ball Engine Co., Erie, Pa., to be direct connected to General Electric dynamos.

THE

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An Admirable Exhibition.

NOTHING stales the infinite variety and charm of electricity, and the present Electrical Exhibition only goes to show how numerous are the opportunities of presenting features of genuine interest and merit. We print elsewhere in this issue not only a full report of the brilliant and memorable opening exercises, but plans of the exhibits and some further notes, in brief form, on what is being exhibited. Any one can see that the work of two years ago, altogether admirable as it was, has been exceeded, and the appeal of electricity to the public driven home with even greater emphasis and effect. Outside the very fine commercial and industrial exhibits, the special features are numerous and effective, some of them highly novel. There would have been more had not the management and its committees already used up every inch of space that could be availed of for such purposes. When we consider that all this has been done in times of war, the wonder of it grows. The fact that there is war may be a lame excuse for the non-participation of some concerns unfortunately left out; but as we have said before, it seems to us that all would welcome such an exhibition not merely as a duty and privilege, but as one of the best means to help build up new arts and create new trade.

It is a little early to speak more than generally of the exhibits themselves. Many of them are really superb. Those of the Worthington pumps, for example; of the New York Edison Co.; of the New York Telephone Co.; of the Edison phonograph interests; of horseless vehicles; of the Sprague, Excelsior, Walker, C & C, Fort Wayne, Crocker-Wheeler, Eddy, Paragon, Bullock, Ziegler, Card, Safety, Roebling, Electric Storage Battery Co., are all remarkably fine; while the corresponding steam engine oil engine, and boiler exhibits in the basement are no whit behind. We commend them all for careful inspection and study. We may mention with special praise the operative street car exhibit showing the application of the underground trolley, on a regular stretch of track, with a Stephenson car, Walker motors, and all the plow and circuit mechanism in full view. As a method of showing everybody how the thing is done, this could not be surpassed. High praise of the same kind is deserved by the lovely McIntire "arcolier," and by the "magnetic" exhibit, which includes Mr. Edison's ore separation and seven-ton rocks, on the practical side, and Mr. Schoonmaker's beautiful demonstration of the field of force, on a large scale, on the scientific side.

And so one might go on, but we should soon drift into a long catalogue of interesting features. That every one will be delighted with the artistic Moore chapel, and its lighting by vacuum tubes, goes without saying. There is much educational work attempted at the Exhibition, and it will be instructive to note how the public takes to the method of combining wax tableaux and books about the periods illustrated, as a new style of making scientific study popular. We are ourselves of the opinion that they, with the popular lectures to be given, will do much to give a further hold of electricity on the public mind as a thing worth looking into and as an agency so all pervading as to be that about which, above all others, an intelligent man or woman ought to know something.

Thermo-Electric Batteries.

FAR-REACHING and full of promise as is the question of how to obtain electricity direct from coal, broader and therefore more inviting still is the problem of the direct production of an electric current by the application of a source of heat. In the solution of this problem it matters not whether a change of chemical, physical or magnetic conditions is brought about or what materials or methods are employed to arrive at the desired end. Countless have been the investigators in this attractive field and innumerable have been the methods devised for accomplishing a purpose which holds out to the successful experimenter both fame and wealth. One of the most indefatigable experimenters with thermo-electric batteries and one who has always upheld the theory that the electrical energy produced in cells in which heat is applied is primarily due to thermo-electric, and not a chemical action, is Mr. C. J. Reed. To prove this fact Mr. Reed has performed numerous experiments in the past few years and his latest apparatus was described by him in a paper read before the A. I. E. E. on April 27. The apparatus consisted of a fused mass of caustic potash or soda maintained at a temperature of from 500 degs. to 800 degs. C., into which two conducting rods are inserted, both of the same metal, and as nearly alike as possible in every respect except form. One of the rods is of cylindrical form; the other is in the form of a cylinder having a deep recess cut or turned out near one end, leaving at the end a short cylindrical head attached to the rod by a very narrow stem. With this arrangement, therefore, he has two pieces of metal as nearly alike as possible, in chemical composition and molecular structure, subjected to the same conditions in all respects, except that the temperature of one at its junction with the electrolyte is higher than the temperature of the other at its junction with the electrolyte. In other words the electrolyte has one hot and one cold junction with pieces of the same metal inserted in it to the same depth and subjected, so far as known, to no other disturbing influences. This arrangement gives an electromotive force varying with the temperature and constitution of the electrolyte between —0.2 volt and +1 volt. Mr. Reed referred in detail to the experiments of Liebenow and Strasser, pointing out the close relation which exists between the electromotive force and the temperature of the electrolyte. He claimed that the development of an e. m. f. cannot be the result of chemical action, but that the rods evolve electrical energy and exhibit a high e. m. f. under circumstances that are identical in all respects, except temperature, and that the action is, therefore, thermo-electric.

In the discussion which followed the reading of the paper, Mr. Steinmetz argued that the great change in e. m. f. due to a comparatively small change in temperature when the alkali became dehydrated, indicated a chemical action. This he believed was due to the greater affinity of the hotter rod for the oxygen than that of the cooler one, and that therefore more energy would be developed at the hotter electrode than at the cooler one. He believed that the heat energy was first transformed into chemical energy, similar to the combination of hydrogen and oxygen by means of heat, and that this chemical energy was then transformed into electrical energy, the operation performing a complete cycle. This theory, Mr. Reed replied, was neither proved nor disproved by his experiments, but they did show that the source of the energy was heat. Mr. Mordey, of London, prefaced his discussion by a few remarks in which he thanked the members of the electrical profession on this side, for the many kindnesses shown to him during his visit to this country. He expressed the opinion that chemical action must take place in the cell at that high temperature, especially as there is a difference of temperature between the two electrodes. Mr. Mailloux brought out the fact that if molten lead be substituted for the fused electrolyte, the e. m. f. would be considerably lower. This may be due to the greater thermal conductivity of the molten metal, which prevents the establishment of as great a difference of temperature as is possible when the fused alkali is used. The discussion, which might have been continued in-

definitely but for the lateness of the hour, seemed to point to the fact that, regardless of the simplicity of Mr. Reed's experiments and apparatus, there still exists a great deal of speculation and uncertainty as to the source and cause of production of the electrical energy. The subject is one still open for discussion, and one on which more thought and labor can be most profitably spent.

English Experience with 220 Volt Lamps.

THE 220 volt lamp, ushered in a short time ago, with great expectations on the part of the central station man and consumer, seems to possess some inherent faults which, if not remedied, may check its rapid introduction. The faults and difficulties of manufacture of the high voltage lamp are clearly pointed out and remedies suggested by Mr. Binswanger Byng in a valuable paper read recently before the London Institution of Electrical Engineers. The lamp manufacturers, he pointed out, have been compelled to supply 220 volt lamps at a given candle power and efficiency in the same size bulbs as are used for 110 volt lamps. With flashed carbons the manufacturers meet with great practical difficulty of properly disposing their long thin 220 volt filament in the same space as their shorter and thicker 110 volt filament, and therefore most of them solve this problem by resorting to a filament of much higher specific resistance than would be given by the flashing operation. The filaments of high voltage lamps largely used to-day are, on account of the omission of the flashing process, faster converters of energy into heat and light than flashed filaments of the same candle-power and efficiency, although the watts supplied to each be the same.

On comparing the behavior of such 220 volt lamps with that of 110 volt lamps, the roughest of tests shows that there is a far more rapid falling off of candle power during life with the former than the latter. At the same time the efficiency of an unflashed lamp decreases in a given number of hours by a far greater percentage than is the case with the flashed lamp. Mr. Robertson has made a series of life and efficiency tests on high-voltage lamps. They show that on the average unflashed 220 volt 16 candle power lamp the percentage loss of candle power in 600 hours is about 42 per cent., and the average drop of efficiency is about 35 per cent. The author further points out the disadvantages of the high specific resistance of filaments which have not been flashed, and that the occluded gases are retained in a far more persistent degree by high specific resistance filaments than the low specific resistance flashed filaments. As the same size of bulb has been retained for the 220 volt lamps as was used in the 110 volt lamps, it is impossible to give a greater separation between the leading-in wires of the lamp. This question is a vital one, and one which might prove very disastrous to the life of the lamp. Electrostatic effects also increase with the voltage and the "Edison effect" or leakage current which leads to short circuiting is also very marked during the manufacture of the high voltage lamp. Mr. Byng sums up the situation with the assertion that "with our present knowledge, the best form of 200 volt lamp is that which has a well flashed low specific resistance pure carbon filament in a large bulb, with a well insulated moisture proof cap allowing the poles to be placed at a reasonable distance apart. It should consist of a single filament, and be so disposed in the bulb that it can withstand the disturbing effects of gravity and electrostatic charges on the bulb."

Mr. Byng's propositions for the solution of the problem were not denied, but rather encouraged by those who participated in the discussion of this highly interesting and timely paper. The result of the discussion may be summed up as follows: At the present time the 220 volt lamp is not as efficient nor as durable as the 110 volt lamp, and in order that the consumer may keep down his bill for current he must spend money in more frequent renewals of his lamp. This is offset, however, by the fact that the introduction of high voltage will reduce the expenses of the generating station, which will, in turn, reduce the price of current. The reduction of first cost in laying the mains will also enable the stations to extend their territory and supply current economically to scattered districts and suburbs. The above, it must be borne in mind, are the results of English experience, which do not seem to be borne out fully on this side of the Atlantic where, according to the reports from manufacturers and consumers, the 220 volt lamp has found a ready and extensive market and is giving good satisfaction.

The General Electric Report.

WE print elsewhere a full abstract of the General Electric Company's report covering the year 1897. The striking feature of this report as compared with that of the previous year is the fact that the gross earnings were less by nearly $300,000 than those of the year previous, while the expenses were increased by more than $500,000. This showing is strong evidence of the fact that while the company may have been comparatively busy, the prices obtained must have been low. This view is borne out by the fact that in all departments at the company's works the sales show increases over previous years of business. Thus, in the lighting department there is an increase of nearly 6 per cent., in the power and mining department an increase of 60 per cent., in the railway department 33 per cent., and in the supply department we find increases varying all the way from 20 to 92 per cent. Even the sales of incandescent lamps showed an increase of 10 per cent.

One cannot but deplore the state of affairs existing in the electrical trade, as exemplified by this showing. It is probably true that prices have bettered slightly during the past few months, and that had the financial statement been drawn within the last thirty days the showing would have been a better one, but as it stands it indicates very strongly that some radical measures will have to be undertaken to put the company on a dividend earning basis. This of course has been realized some time ago, and that such action may shortly be looked for is very definitely foreshadowed in President Coffin's report, in which he points to the early reduction of the share capital of the company with a view to the resumption of dividends. We believe that such a course is a wise step and would react favorably on the entire industry. It needs hardly to be pointed out that, however carefully a non-dividend paying corporation may be managed, the very fact that no dividends are expected to be paid acts as a drawback in many ways; the converse of this proposition is self-evident.

It will be noted that the company places the value of its patents and franchises at $8,000,000; this figure, which has long been criticised, has perhaps less justification now than ever. The recent refusal of the Circuit Court of Appeals to sustain a preliminary injunction on the Vandepoele patent has still further shaken the ground on which that figure is based. But President Coffin seems to find some consolation in the fact that the business of the future will tend largely toward the third rail and the underground conduit, so that he anticipates that an adverse decision in the Vandepoele patent will have no marked effect on the business of the company. We sincerely hope with President Coffin that such may prove to be the case. But whatever criticisms may be brought against the company, there is no question of the fact that it has put its house in good order for business. Its factories are generally acknowledged to be in excellent condition, and although its stockholders may be yearning for dividends, no creditor is knocking at the door. What with the general revival of trade during the opening months of the present year and the heavy Government business entrusted to the company, it is more than probable that next year's balance sheet will show a decided improvement over that for 1897. Besides, the foreshadowed scaling down of the company's share capital will put it on a dividend paying basis, even on the present showing.

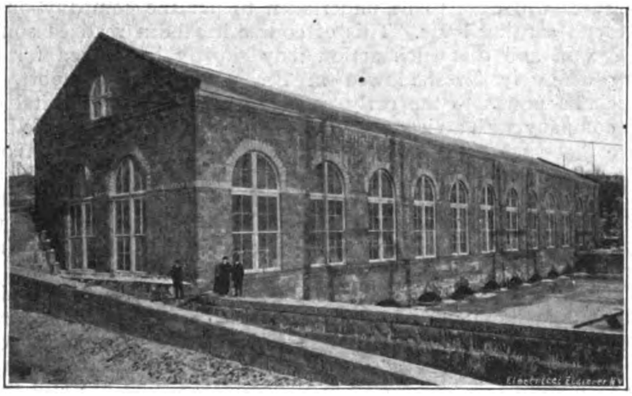
LEGAL NOTES

Decision in Favor of the Fischer Foundry and Machine Co.

The controversy between the Fischer Foundry and Machine Co., of Pittsburg, Pa., builders of the "Fischer" engine, and the Weston Engine Co., of Painted Post, N. Y., builders of the "Imperial" engine, regarding the infringement of certain patents relating to self-oiling engines, has been decided in favor of the Fischer Foundry and Machine Co. This decision, it is claimed, affects some other builders of self-oiling engines, and may result in a modification in the existing designs of this type of engine.

Electrical Utilization of the Falls of St. Anthony, Minneapolis, Minn.

IN our issue of June 2, 1897, we announced the completion of the extensive works on the Mississippi River at Minneapolis, Minn., by which a great part of the power of the lower Falls of St. Anthony is utilized. This undertaking marks an epoch in the history of the twin cities of the Northwest and brings into extensive use by means of electricity, another of the important waterfalls in this country. The article, referred to above, gave a detailed description of the hydraulic work at the Falls and a description of the power house and was accompanied by illustrations showing the dam at high water viewed from the west side of the Mississippi, a map of the St. Anthony Falls transmission plant, a view of the dam at low water showing the bear trap gates and a view of the power house during high water. Since the publication of that article, important additions have been made in the power house, and numerous substations have been constructed, the details of which will certainly prove of interest.


EXTERIOR OF POWER HOUSE, ST. ANTHONY FALLS, MINN.

HYDRAULIC EQUIPMENT IN POWER HOUSE.

Each hydraulic unit consists of four horizontal Victor turbine wheels, manufactured by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. Each wheel is 42 inches in diameter and runs at a speed of 130 revolutions, giving 250 h. p. They are erected in the turbine chambers, 4 wheels in each, giving a total power to each hydraulic unit of 1,000 h. p. The water passes separately into each flume through two head gates, each 8 feet wide and 9 feet high, operated by a hoisting attachment on the deck of the wheel chamber. Each set of four turbines discharges into a separate arched tail race tunnel the full width of the wheel chamber passing under the power house and discharging into the main tail race below. This tail race is 207 feet wide and 100 feet long. The bottom of the floor together with the foundations for carrying the masonry of the power house is made up of a solid bed of concrete 22 feet square and 2 feet thick. At the eastern side of the power house are two pairs of 21-inch horizontal wheels for the exciters, arranged for operation independent of the other machines, if necessary. These are from the works of the D. S. Morgan Wheel Company, Dayton, Ohio.

In the operation of all water turbines, the question of proper control is not the least important. The governor employed to control the flow of water to the wheels is the "B" type of Lombard governor, guaranteed to hold the normal speed of the wheels constant and the momentary fluctuations due to a large load to within 5 per cent. of normal under any conditions. It is belted to a small pulley on the generator shaft. It consists primarily of a governor directly controlled and a small hydraulic ram which controls the distribution to a second ram which in turn actuates a third ram acting directly on the gate closing mechanism.

THE DYNAMO ROOM.

The dynamo room of the power house is a long single chamber, finished in hard wood, with a gallery 10 feet wide running the entire length of the east wall. In this gallery are placed the switchboards, transformers, and instruments, together with the general offices, drafting rooms, etc. The main room is lighted by 15 windows, each 12 feet by 25 feet. The gallery is lighted by 10 windows, each 4 feet by 7 feet. An electric traveling crane runs the entire length of the dynamo room.

In the design and construction of this station provision has been made for a steam plant of equal capacity to that of the hydraulic plant. Opposite each generator will be erected a 1,000 h. p. engine which can be coupled to the dynamo for use in the event of scarcity of water or extreme frost. This will necessitate also the building of a boiler plant, but the installation of the steam plant has not yet been commenced. The ultimate capacity of the plant is 10,000 h. p. in ten units of 1,000 h. p. each.

The system of distribution contemplated is a combination of direct current for the service of the Minneapolis railroads in the vicinity of the power house, and of three-phase alternating current with converter substations for the out-lying districts and for the St. Paul roads. Five alternators and two direct current machines are now in position. Two alternators and one direct current machine are still to be erected.

THE GENERATORS.

The alternators are of the revolving armature type, having 36 poles and giving an output of 700 k. w. (1,000 h. p.) at 3,450 volts when running at the speed of the wheels, 130 revolutions per minute. The frequency is $34\frac{2}{3}$ cycles. Each alternator stands 10 feet 8 inches high on a base 12 feet 6 inches by 10 feet $10\frac{1}{2}$ inches. The armature shaft is extended 12 inches beyond the outer bearing to allow the engine coupling to be attached when the contemplated steam plant is installed. The poles, cast into the soft steel field ring are laminated, the laminations being insulated from each other by a heavy coating of Japan applied to each side of each lamination. The ring is ribbed to increase rigidity. The field winding is made upon shells, from which it is thoroughly insulated, and both poles and winding are arranged to allow of easy removal of the latter from the yoke without disturbing either armature or field structure. The base, also of cast steel, is constructed to allow of movement of the field frame parallel with the shaft. This method allows the armature to be inspected and in case of necessity repaired without unbolting and raising the upper part of the field ring. The bearings are made of extra length, are self-aligning, self-oiling and lined with babbitt.

The armature is of the slotted core or ironclad type, the laminations, dove-tailed into a spider to avoid the use of bolts through the core, being arranged to allow of radial ventilating ducts $\frac{3}{8}$ inch wide. The laminations are thoroughly insulated before the introduction of the coils, which are previously shaped on forms and are amply insulated. The internal diameter of the armature is 7 feet 6 inches. The peripheral speed is 3,140 feet per minute, and the air drawn in through the spider and passing through the ducts just mentioned, thus circulates throughout the core and thoroughly ventilates the armature. The collector rings are assembled on a separate spider, and are insulated from it by heavy moulded mica, and from each other by thick insulation discs. Connection between the rings and windings are arranged for ready disconnection if necessary. The test applied to the rings is of three times the running potential between them and the shell.

The weight of the armature complete is 25,000 pounds, of the entire machine 84,000 pounds.

The two direct current generators are standard eight-pole machines giving 700 k. w. when running at 130 revolutions per minute. The no load pressure is 575 volts, and the machines are over compounded to 600 volts. Each is coupled to the turbine shaft in manner similar to the alternators, and the shaft is also extended to receive the engine coupling.

These machines are standard General Electric railway generators, with the construction of which most of our readers are familiar. Briefly, the ribbed field ring is of cast steel as are the poles and field windings in the alternators. The spools are of malleable iron on which the series and shunt windings are placed in separate compartments, rendering each accessible with equal ease. The armature is ironclad, built up of Japanned laminae, dove-tailed to the spider and ventilated by radial 4-inch ducts.

The winding is of insulated copper bars laid in insulated slots. It is known as the "barrel" winding and gives the completed armature the form of a perfect cylinder. The commutator and shell are forced over an extension of the armature spider, obviating movement of the shell with respect to either spider or windings. The commutator bars are of hard drawn copper, insulated from each other by mica. A large number is used to give a very low voltage between segments, not exceeding 8.8 volts, when the machine is running at 630 volts. The brush ring is of the latest type, as are the brush holders. A hand wheel controls the movement of all the brushes, which are shifted, raised from or depressed upon the commutator simultawheel controls the movement of the brushes, which are shifted, raised from or depressed upon the commutator simultaneously.

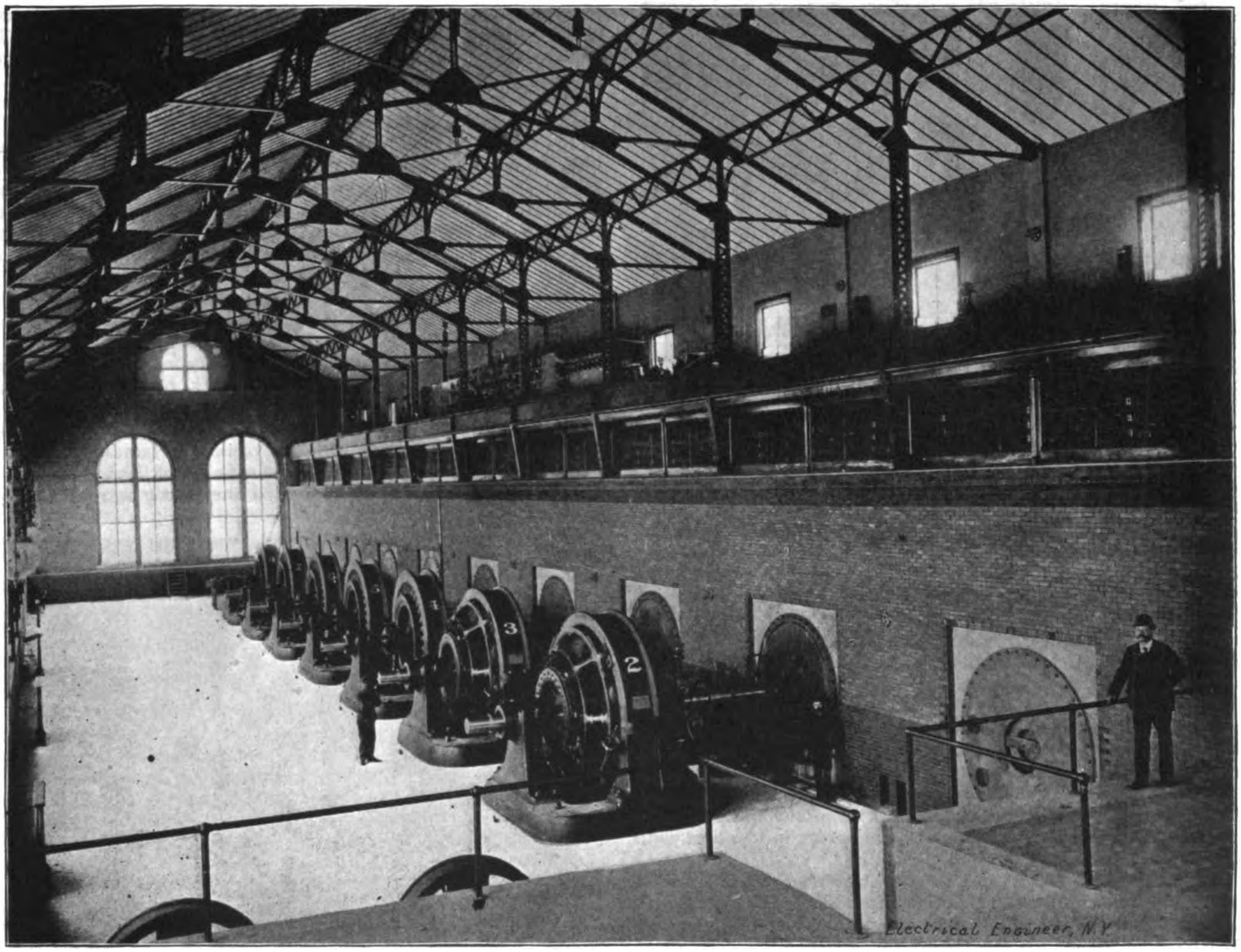
THE EXCITERS.

The exciters are six-pole, 100 k. w., direct current machines, directly coupled to the smaller wheels, and running at 280 revolutions per minute, supplying current at the same pressure as the main direct current generator. In all details of construction, they follow the larger direct current machines last mentioned. The diameter of the armature is 31½ inches, the peripheral speed 2,300 feet per minute, and the ventilating ducts ½ inch wide. The weight of the armature is 3,200 pounds.

The step-up and step-down transformers number twenty-one. Six step-up of 233 k. w. capacity and 15 step-down of 215 k. w., giving a total transformation capacity of 4,623 k. w. All are of the air blast type, and are built up of well tested iron laminations supported on and well insulated from, an iron frame, and divided into sections. Ducts running up through the sections allow of perfect ventilation by cool air forced through them, from underneath and controlled by means of shutters at the top. In general construction these transformers are similar to those built by the General Electric Company and used in the Niagara Falls-Buffalo transmission and the great transmissions of the West. The draft of air to cool the generating station transformers is furnished by a 60-inch blower driven by a four-pole direct current 600 volt motor direct connected to the fan shaft. It supplies 3 cubic feet of air per minute with one ounce pressure per kilowatt to the transformers, while the energy required to drive the motor is little more than one-tenth of one per cent. of the full load kilowatt capacity of the transformers. The efficiency of these transformers is about 98 per cent. They are designed for extremely close regulation varying only one per cent. from no load to full load. Before shipment each transformer was tested to 20,000 volts. Each weighs 4,500 pounds, stands 58 inches high on a base 38 inches by 32¾ inches.

SWITCHBOARDS.

The main switchboard is a handsome structure, occupying the gallery looking down upon the row of generators. It is of the standard G. E. panel type divided into alternator, railway generator and exciter sections—23 panels in all. The panels are of blue Vermont marble and all metal work on the front is highly polished.

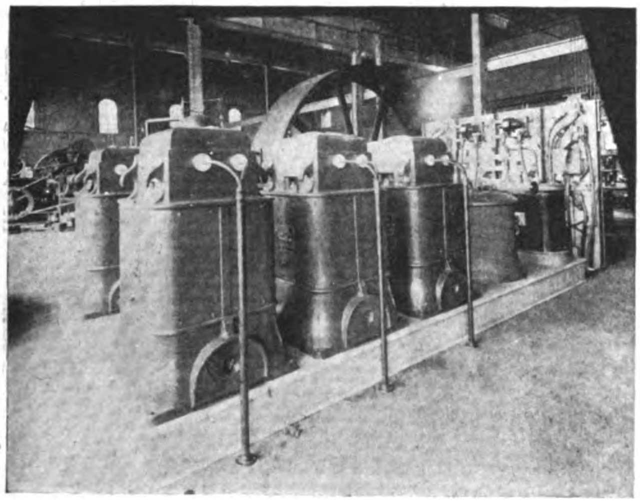


INTERIOR OF POWER HOUSE, ST. ANTHONY FALLS, MINNEAPOLIS, MINN.

The alternating switchboard consists of one panel for each alternator and five alternating current feeder panels. The arrangement of the bus-bars and switches on the latter allows any generator to be run separately to each feeder, or all in parallel, and to give two sets of independent bus-bars for convenience at moment of starting the rotary converters. The direct current switchboard consists of two generator panels, eight double feeder panels, and a station panel, the latter carrying a 700 volt voltmeter and 2,500 ampere G. E. station output

Thomson recording meter. The exciter board has two panels, one for each machine.

All the panels are set up in a continuous line, the alternating current panels at the west end of the board, the direct current panels at the east end. Extensive use is made on the alternating panels of the Thomson inclined coil type of instruments both ammeters and voltmeters. The alternating switches are of the new G. E. porcelain chamber plunger type. Each direct current generator panel carries a 1,500 ampere K circuit breaker and a 1,500 ampere illuminated dial Weston ammeter in addition to the other standard devices and each feeder panel has a 300 or 500 ampere circuit breaker and 200 ampere round dial ammeter.



NO. 1 SUB-STATION, TWO MILES FROM POWER HOUSE, ST. ANTHONY FALLS, MINN.

The exciter panels carry illuminated dial voltmeters and round dial ammeters.

ELECTRICAL DISTRIBUTION.

The direct current is fed from the switchboard directly into the main railway overhead system of Minneapolis, over lead covered cables, some running to the trolley line direct and others to a wire tower about 200 feet from the power house, from which the cables run to a pole line feeding the cars between Minneapolis and St. Paul. The system of distribution of the alternating current is more complex, and involves the use of three separate transformation and conversion plants, two in Minneapolis and one in St. Paul.

All are installed in the buildings containing the steam plants, shortly to be discarded entirely, of the Twin Cities Rapid Transit Company. Substation No. 1 is located near the center of Minneapolis, two miles from the power house. It contains six step-down transformers, two induction regulators, two alternating and two direct current switchboards and two 600 k. w. rotary converters. Substation No. 2 is located about four miles from the power house, and contains three transformers, and one converter. Substation No. 3 is in St. Paul and ten miles distant from the power house. Its equipment is identical with that of No. 1.

To substations No. 1 and 2, the current is transmitted at 3,450 volts over two triple conductor paper insulated lead covered cables, laid in cement lined iron conduits furnished by the National Underground Conduit and Cable Company. The manholes are placed as nearly as possible 500 ft. apart. It is taken from the switchboard first through a series of General Electric alternating current lightning arresters, similar in construction and operation to those so successfully used in the long distance transmissions of California, Utah, Colorado, Montana and elsewhere. From these it continues to the step-down transformers, in which the pressure is reduced to 387 volts. At this pressure it enters the converter switchboard and then passes to the alternating current side of the converters, issuing from the commutator side direct current at 600 volts. It then passes through another switchboard to the Minneapolis overhead wires.

To transmit the current to St. Paul involves the use of step-up transformers at the power house. The alternating current passes into these at the initial voltage of 3,450 volts and is raised to 12,000 volts, at which pressure it enters the transmission line, passing first through a bank of lightning arresters. The line consists of triple conductor, paper insulated lead covered cable, one cable only being used. At substation No. 3 the line is connected to step-down transformers. A similar transformation and conversion is effected as in the case of substations 1 and 2 and the current enters the main St. Paul direct current net work at normal working pressure.

The construction of the step-down transformers is similar to that of the raising transformers and they are cooled in the same manner. The blowers in the substations are 50 inches in diameter, and are directly connected to four-pole 550 volt motors. The amount of energy consumed in driving the motors is the same as in the case of the step-up transformers.

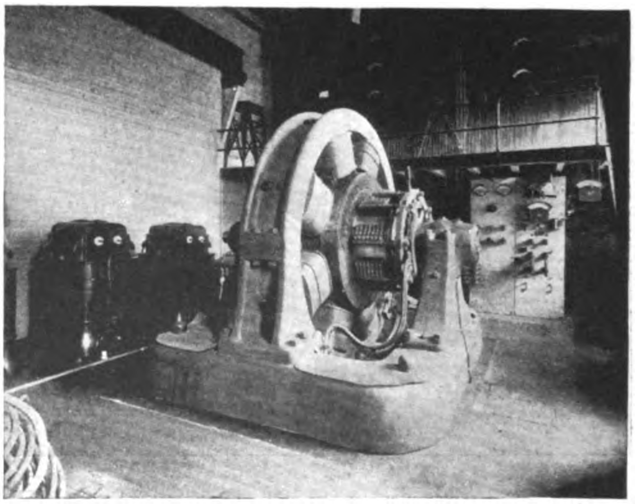
THE CONVERTERS.

The rotary converters are eight-pole machines of 600 k. w. capacity, running at 530 revolutions with a direct current voltage of 580 volts at all loads up to normal. The alternating current voltage is that of the secondaries of the step-down transformers—387 volts. The circular yoke of these machines is of cast steel, the inwardly projecting poles being of the highest grade steel. The poles and spools are arranged for easy removal from the yoke without disturbing either it or the armature or yoke. The spools are wound upon malleable iron shells and carefully insulated from them. The armature is of the ironclad type with ventilating ducts 5-16 inch wide.

The laminations, similar to those already described and similarly insulated, are mounted on a spider and the winding of the copper bars is insulated and laid in insulated slots. The interior diameter of the armature is 72 inches, giving a peripheral speed of 7,500 feet per minute. The commutator is assembled on a separate spider and a large number of segments used to bring the voltage between the segments, as low as possible. The collector is also assembled on a separate spider. In the construction of the bearings the same principles which govern the bearings of the large generators are employed, that is, they are self-oiling, self-aligning and of ample size. The lining is of hard babbitt metal.

The approximate weight of each rotary converter is 17,500 pounds for the revolving part and about 51,000 pounds for the complete machine.

Owing to the comparatively short distance between the generators and the rotaries, and the use of underground cable rather than an overhead line, artificial inductance has been introduced to secure the necessary flexibility in the direct current voltage



NO. 2 SUB-STATION, FOUR MILES FROM POWER HOUSE, ST. ANTHONY FALLS, MINN.

of the rotary. This inductance consists of a three phase open magnetic circuit inductance coil placed between the transformer and each rotary, and allows of a great range of adjustment in the direct current voltage. The coils are bundles of iron wire wound with a finely stranded cable. They are assembled in protecting cases and are cooled by a current of air taken from the blower which cools the transformers. These coils are also useful in preventing idle current from circulating between the two rotaries operated from the same transformer, should their field adjustment not be carefully made.

The switchboard in substations 1 and 2 consists of two alter-

nating and two direct current panels in each. In substation No. 2, one alternating and one direct current panel. These switchboards are of blue Vermont marble and in general construction resemble the switchboard in the generator station. The alternating current panel carries inclined coil instruments and single-pole quick break switches of 1,000 amperes. The continuous current panels are equipped with circuit breaker, illuminated dial voltmeter and the usual standard equipments.

In order to protect the rotaries in case of reversal of current, an automatic device is provided in each direct current panel. In case the current on the direct current side should be reversed a circuit breaker is automatically brought into action to break the circuit and protect the machine. The entire electrical equipment was installed by the General Electric Company. The aggregate weight of the electrical machinery is considerately over 1,000,000 pounds.

The president of the St. Anthony Falls Water Power Company is John J. Pillsbury, whose extensive interests in Minneapolis are well known; Wm. de la Barre is chief engineer, agent and treasurer, and Edward P. Burch, electrical engineer of the Twin Cities Rapid Transit Company has had charge of the electrical work. It will thus be seen that in bringing this plant to completion, the engineering forces of both companies have worked harmoniously together. Before beginning the work, data was obtained by personal visit to every electrical transmission plant of importance in the United States, and the result is one of the most perfect, and the most modern installation now in operation.

LETTERS TO THE EDITOR

Liquid Air.

IN the last issue of The Electrical Engineer Mr. W. H. Dickerson, in a letter to the editor, criticised certain portions of the writer's article on liquid air which appeared in The Electrical Engineer of April 14. He stated that the description of apparatus as well as the cost of producing liquid air, was wrong.

It is to be admitted that little is known regarding the details of Mr. Tripler's apparatus, since he has endeavored to keep this as secret as possible. The writer's description of this was gleaned from what Mr. Tripler so kindly allowed him to see at the laboratory, as well as from explanations made at that place some six weeks ago. The process, as explained in the article, is essentially correct. At the same time the statement was made that with the expenditure of forty horse power, the output of the station would be about forty gallons for a ten hour run. That is 10 h. p. per hour can produce about a gallon of liquid air, which was the statement made by the writer in the article. It is, of course, possible that the apparatus might have been materially changed during the last month, thus affecting the cost of production. The writer only endeavored to give a general description of what could be ascertained at the time.

In the article an account was given of Prof. Peckham's lecture, but no attempt was made to name the originators of each particular experiment, as this seemed unnecessary, since the experiments were drawn from all available sources. It was not the intention of the writer to detract any credit that is due to Mr. Tripler.

The writer's statement concerning the loss of heat which a jet of steam experiences in being converted into ice is so obvious to almost any one that it hardly needs explanation. If Mr. Dickerson will take the trouble to look up the subject in any book on elementary physics he will be convinced of the correctness of the figures, as well as of the terms.

Again, if Mr. Dickerson will look up some of the back numbers of "Nature," he will find that a glass receiver protected by a Crookes vaccuum was first applied to refrigerating work by M. Cailletet, of Paris, and was popularized, but not invented, by Dewar, as he would want us to believe from his letter. Such errors are of course "very unprofessional and distasteful to readers conversant with the facts," especially since "courtesy should demand that credit be given to the originators."

SOL. D. BENOLIEL.

Brooklyn, N. Y., April 28, 1898.

LITERATURE

MAGNETS AND ELECTRIC CURRENTS. By J. A. Fleming, M.A., D.Sc., F.R.S., London, 1898. E. & F. N. Spon. 408 pages. 5 x 7½ inches. Cloth. Price, $3.00.

This book may be considered as taking the place of a volume published by Prof. Fleming about twelve years ago entitled, "Short Lectures to Electrical Artisans," which was a reprint of a course of lectures given to the pupils and workmen at an electrical engineering factory. The information contained in that brilliant little volume has been thoroughly recast so as to conform more nearly to the present state of knowledge; and it is evident that the author has fulfilled his original aim of supplying electrical artisans and engineering students with a brief, thorough and elementary account of the scientific principles underlying modern applications of electricity in engineering. With this object in view the use of mathematical symbols has as far as possible been avoided, which at once enables the non-mathematical student to read the book intelligently and understand its contents.

Perhaps the most striking feature of the book and one which may be subject to some criticism and elicit discussion on this side of the Atlantic is the introduction of the new terms and phrases proposed by Mr. Heaviside and others, but which have not as yet been universally accepted. We refer to such words as gaussage and gaussivity, voltivity, fluxage, fluxivity, etc. Should these terms, however, be universally recognized in the near future, and we trust that they will be, their introduction into the text of this book will make the latter more valuable and up-to-date than any other similar publication.

The book is divided into ten chapters, which deal respectively with magnets and magnetism, measurement and units, magnetic force and magnetic flux, electric currents and electromotive force, the measurement of electric currents, electromagnetic induction, electromagnets, alternating currents, electric measuring instruments and the generation of electric currents. A striking feature of the book is the symbol $\frac{\text{E.}}{\text{C. R.}}$ imprinted on the cover, the use of which will not seem apparent until the reader receives the following instructions on page 133: "Cover over with the finger any letter, say C (current) and the position of the remaining letters $\frac{\text{E}}{\text{R.}}$ denote that the numerical value of the current is equal to that of the e. m. f. divided by that of the resistance. In the same way it is seen that the e. m. f. (E) is equal to the product C R of current and resistance."

NEWS AND NOTES

A Substitute for Platinum in Incandescent Lamps.

According to a German contemporary, experiments with iron-nickel alloys have shown that different co-efficients of expansion are obtained according to the percentages of the two metals. An alloy containing 45 per cent. of nickel has the same co-efficient of expansion as platinum, and it is stated that this has been confirmed by experiments made at the Reichsanstalt. It is proposed to use this alloy to replace platinum in the manufacture of incandescent lamps. An interesting paper read before the Société Internationale des Electriciens by M. C. E. Guillaume, has described recent experiments on the expansion and magnetic properties of steel-nickel alloys.

"Maritime Electrical Association" for Canada.

A well attended meeting for the organization of a Maritime Electrical Association was held at the Halifax Hotel, Halifax, N. S., on the 12th inst. A large number of gentlemen were present and were unanimous in their support of and sympathy with the movement. A constitution was adopted and the fol-

lowing officers were elected: President, F. A. Bowman, superintendent New Glasgow Electric Co., New Glasgow, N. S.; Vice-President, H. Colpitt, City Electrician, Halifax, N. S.; Secretary-Treasury, J. H. Winfield, Nova Scotia Telephone Co., New Glasgow, N. S. A representative executive committee was also elected. It was decided to hold the first regular convention at Halifax some time in September. The association starts out with a good membership list, and it is confidently expected that good work will be done in bringing together all those engaged in the electrical business for mutual exchange of ideas.

JOSEF HOFFMAN, the brilliant young pianist, is said to be passionately devoted to mechanics and electricity. He has invented various forms of telephones and electric lights, as well as batteries and other appliances.

Opening Exercises of the Electrical Exhibition.

TO say that Madison Square Garden was packed on Monday night would be using a mild term. Fully 10,000 people swayed and surged on the main floor and in the galleries, attracted by what proved to be one of the most interesting exercises ever held in connection with the opening of an exhibition. It was almost 9 o'clock when Chancellor McCracken, of the New York University, opened the exercises by an invocation.

Dr. Chauncey M. Depew was then introduced as orator of the evening and, needless to say, his appearance was the signal for prolonged cheering. Dr. Depew delivered one of his characteristic patriotic addresses, for which he had abundant material to work upon, considering the events of the previous forty-eight hours. He referred, among other things, to Franklin who, as he said, was never astonished at anything, whom no combination of circumstances could phase, whose sangfroid never left him, even in the presence of royalty. Yet, with all that, Dr. Depew ventured to suggest that if Benjamin Franklin could have been present there on that evening he would have been astonished. Again, Dr. Depew alluded to the glorious victory obtained by Commodore Dewey at Manila, and pointed out that it was to the cultivation of science in America that such results were made possible. Had Spain shown equal love for science and its industrial applications, no conflict between that country and this would probably ever have occurred. Science made liberty, and when Dr. Depew waved the American and English flags in either hand and called for three cheers for the combined English speaking nations of the world, who have always stood for light and liberty, the enthusiasm was unbounded and the cheering deafening. Many passages throughout Dr. Depew's speech gave rise to patriotic outbursts.

Dr. Depew then read the following message from President McKinley, sent from the White House at Washington by means of the same golden key used by President Cleveland, to open the Chicago World's Fair in 1893.

OPENING TELEGRAM FROM PRESIDENT M'KINLEY.

"It gives me great pleasure to open the Electrical Exhibition in Greater New York, and to participate in this wonderful demonstration of the latest method of recording and publishing by means of electricity. I congratulate you upon the achievements of American genius. I am glad to know that the resources of the wonderful electrical arts have already been so far advanced in the United States, that American electrical goods are welcome the world over."

The message came over the wires of the Postal Telegraph Cable Company, the golden Victor key being loaned for the occasion by Gen. E. S. Greeley. The message from the President declaring the Exhibition open was greeted with prolonged cheering; indeed, every mention of the President's name was a signal for general acclamation.

Following the reading of the telegram from the President, Vice-President Hobart sent the following telephonic message from Washington, which was received on the platform at the Exhibition and recorded directly from the receiver on to the recording cylinder of an Edison phonograph.

TELEPHONE MESSAGE FROM VICE-PRESIDENT HOBART.

"I respond with pleasure to the invitation of the New York Electrical Society to assist in opening the Electrical Exhibition held under its auspices at Madison Square Garden, and beg to express my wishes for its success as a means of promoting further advances in the great electrical and engineering arts with which our national fame is already so proudly associated. I congratulate the citizens of the Greater New York that they have this opportunity of studying all that is latest and best in the science to which Franklin, even in the midst of patriotic duties and cares, gave his transcendent genius."

The message came over the lines of the American Telegraph and Telephone Co. (Long Distance Co.), and the New York Telephone Co., and the phonograph was kindly loaned for the occasion by the National Phonograph Co., of Orange, N. J.

A unique performance, illustrating the rapidity with which news is now gathered and disseminated, followed the reception of the messages of the President and Vice-President. As soon as received both of the messages were set up in type on Linotype typesetting machines, loaned by the Mergenthaler Linotype Co., driven by a Lundell motor, loaned by the Sprague Electric Co. As soon as the type was cast it was made up in forms and printed on a platen press, loaned by the John Thomson Press Co., and operated by a Bullock electric motor. From the press the printed sheets were cut by a paper cutter run by a Crocker-Wheeler motor. It took but a few minutes to complete all these operations, and before Dr. Depew had closed his remarks the messages printed on Postal Telegraph Co. blanks were distributed among the audience.

The close of the exercises was signalized by Dr. Depew firing a Cuban dynamite gun, loaned for the occasion by the Sims-Dudley Defence Co., of New York. The feature of the firing of this gun, however, lay in the fact that the fuse was exploded by closing a contact through the medium of the Clark wireless telegraph apparatus. Of course the regular charge of dynamite was not used on this occasion, and for obvious reasons. Finally, Dr. Depew illustrated the method of blowing up vessels by means of submarine mines by pushing down a plunger on the platform, which closed a circuit that exploded a little torpedo in a large tank in the centre of the hall, in which a miniature battleship had been placed. Great havoc was caused by the scattering of water among the ladies surrounding the tank, and loud demands for heavy indemnity were heard on all sides, with talk of forcible intervention. This feature was installed under the supervision of Mayor Smith, of Pompton, N. J. The last feature of th programm was th singing of the "Star Spangled Banner" by Miss Hilke, contralto of St. Patrick's Cathedral, to the accompaniment of Conterno's band, and a splendid ladies' quartet of four cornets, the audience joining in tne singing. The platform was patroled and guarded by the Rugby Cadets in uniform.

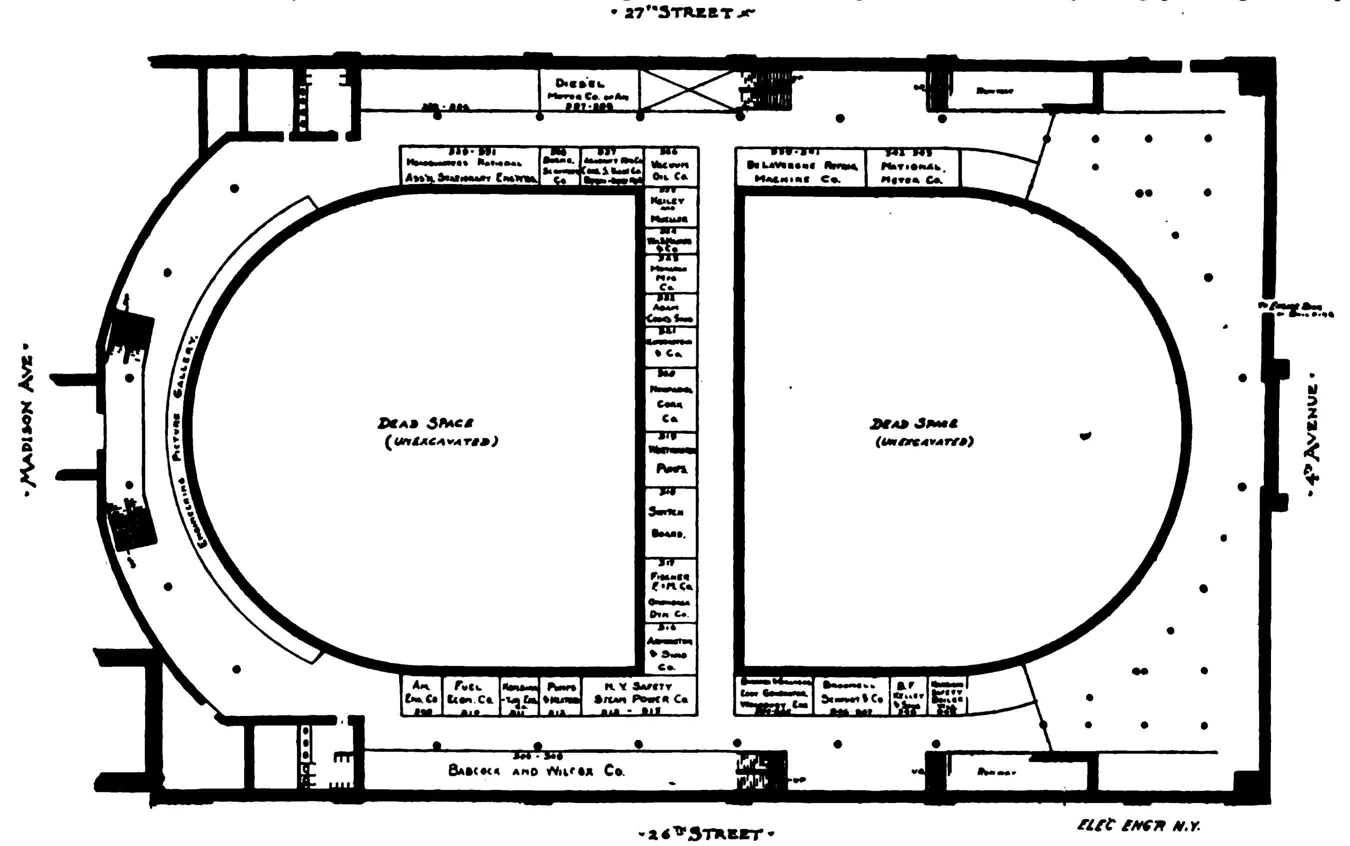
Everybody electrical within fifty miles of New York was present, and many were the expressions of delight at the eminently successful opening of the exhibition. Considering the usual delays accompanying every exhibition at the start, the present condition of the show is little short of marvelous. There were probably not a dozen booths in the entire building which were not in full running order, and by the time this issue reaches our readers the exhibition will be in full swing.

BORNE, SCRYMSER COMPANY, New York, have a number of competent representatives at the Show who are indefatigable in their efforts to extol the merits of their company's oils and the uses to which they are put in electric light plants, both central station and isolated.

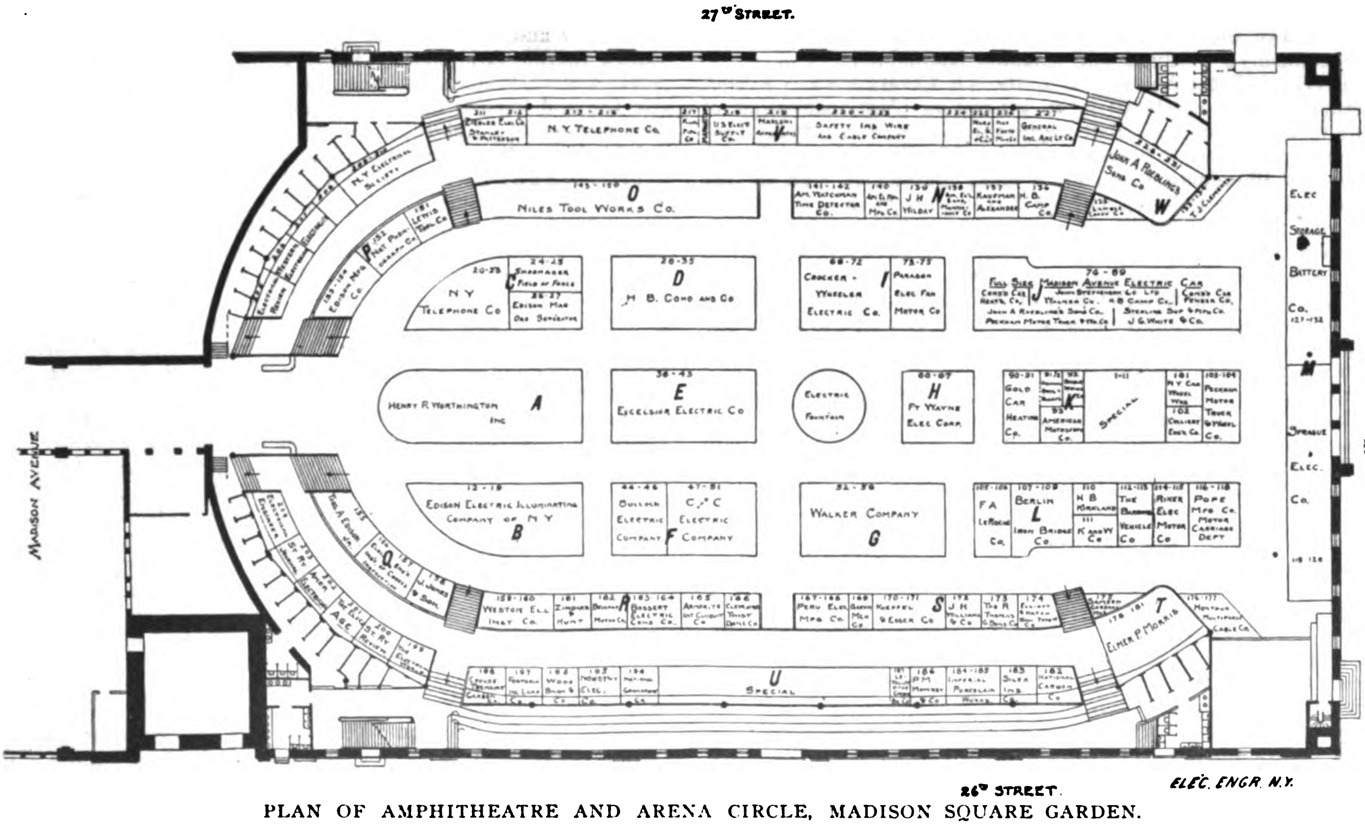
THE EXHIBIT OF THE GARVIN MACHINE COMPANY, New York, is rather limited, owing to the large amount of space that would be needed to exhibit any of their standard lines of milling machines, lathes, planers, shapers, drill presses, grinders, gear cutters, cutter grinders, wire spring coilers, profilers, etc. However, they have gotten together a very interesting exhibit, consisting of a very ingenious and improved twist drill grinder, as well as several small tools. These are supplemented by circulars of their large line of tools which are carried in stock at their store.

The Exhibits at the Electrical Exhibition, Madison Square Garden.

We give herewith plans which show very clearly the location of the exhibits at the Garden, save such as have been arranged for since the plans were prepared, or cannot be placed until after the opening exercises on Monday night, on account of the space requirements for that occasion. Among the latter exhibits are those pertaining to the Amateur model making competition, the personal exhibit of Prof. Short, the apparatus from the Brooklyn Polytechnic, etc., all of which is intended to go in the Arena Circle space marked special. In the basement plan, at the Madison avenue end, the Engineering Picture Gallery is a new feature of great interest, already being put in good shape.



PLAN OF BASEMENT, OPERATIVE EXHIBITS, MADISON SQUARE GARDEN.



PLAN OF AMPHITHEATRE AND ARENA CIRCLE, MADISON SQUARE GARDEN.

In addition to what is shown in these two large plans, there are the exhibits in the Concert Hall and the Assembly Room. These include the eight superb, historical wax tableaux, the Parsell exhibit of electro-deposition work, the third rail model, and the

beautiful Moore chapel, a complete church capable of holding about 100 people nearly all seated, and lit entirely by vaccum tubes. There are also other features of interest in the Concert Hall, for lecture work, etc., and in the Main Hall. Reference to these will be made later.

Exhibit Notes.

OTIS BROTHERS & COMPANY show one of the most interesting electrical appliances in the Exhibition, consisting of a model of their house elevator operated by push button device. This elevator embodies many admirable features which increase the safety and efficiency of the apparatus. In addition to this they exhibit one of their standard electric engines in operation, of which there are some 1,700 in use in this country and in Europe; they also exhibit in connection with the Excelsior Electric Co., of Brooklyn, one of their standard eelectric elevators operated by one Churchward's transformers.

THE CROCKER-WHEELER ELECTRIC COMPANY. It is yet too early to attempt any full description of this company's extensive exhibit, but what it will be like when in full running order can be gathered from the following list of apparatus shown: 150 k. w. direct connected generator, without engine; ½-100 direct motor; 80 k. w. belted generator; 35 h. p. motor; 25 h. p. motor; 15, 10, 3 and 1 h. p. motor. "Size 3" motor-dynamo; "size 5" dynamotor; "size 1" dynamotor; "size ¼" dynamotor. And finally a 10 h. p. mill motor with controller and resistance. The exhibit thus covers a wide range of motor work and will without doubt attract the attention it deserves.

THE C. H. BARROWS COMPANY, of New York, draw large crowds who are attracted by the unique Barrows 3-wheeled motor vehicles, driven by storage batteries. Two of these vehicles are shown. The No. 0 weighs 650 pounds and has a running capacity of 20 miles on one charge. The No. 2 weighs 1,250 pounds and is capable of running 40 miles on one charge.

THE ARMINGTON & SIMS COMPANY exhibit one of their 13 x 12 "1898 Pattern" engines, direct connected to a 50 k. w. Walker generator. The special points of merit in this engine will not fail to attract the attention of visitors.

THE EXHIBIT of the Albany Lubricating Compound and Cup Company is devoted to extolling the merits of the Albany grease and grease cups, for lubricating purposes. All power users, large and small, will find it worth their while to examine the company's products and splendid testimonials.

THE AMERICAN BALL ENGINE COMPANY'S exhibit comprises a complete 25 k. w. generating plant, consisting of one of their American Ball engines and a 25 k. w. direct connected generator. The current from this plant is used for an overhead illumination and for a large illuminated sign on the side wall of the building and for driving one of their multipolar motors, thus illustrating a complete electrical plant of their own manufacture covering the generating of electrical current and its application for both light and power.

BURHORN & GRANGER, of New York, have on view and in operation one of their 9 x 12 inch Woodbury automatic high speed, improved engines, direct connected to a 25 k. w. Eddy generator. This engine is to be set on the present floor without any foundation whatever, to show its perfect running balance, and also to demonstrate with varying loads, etc., by a sensitive recording tachometer that the Woodbury engine with a Shepherd governor regulates within one-half of one per cent. under all conditions in which there is sufficient steam to carry the load. They also show the automatic oiling system and method of valve construction, etc., which enable visitors to understand thoroughly the excellent features of the Woodbury engine.

THE NATIONAL CARBON COMPANY exhibit a complete line of their carbon products, which illustrate strikingly the degree to which carbon enters as a factor in the electric arts. Of course, their large variety of solid and cored carbons for all classes of arc lighting are a prominent feature of the exhibit. But besides these there is a large variety of other products of not less interest and importance. Thus there are to be seen the National and Klondike porous cup cells; special gas engine cells and cylinder cells of various sizes; Fuller type and gravity cells. Among the carbon specialties we note back plates, diaphragms, granular and globular carbon, lightning arrester plates, carbon boxes, strips and tubes; filament blocks; carbon brushes, etc. The whole presents a striking array of products.

THE CROWN WOVEN WIRE BRUSH COMPANY, of Salem, Mass., have a small but neat exhibit, consisting of a show case, containing sample brushes, with circulars, etc. There is also a framed exhibit of woven wire dynamo brushes.

SAMSON CORDAGE WORKS have a show case near one of the main flights of stairs at the Exhibition, containing big sample coils of "Samson Spot" arc lamp cord, trolley cord, bell cords, couplings, etc. These are of considerable interest to visitors at the Exhibition, as some trouble has been caused by using poor qualities of cord for these purposes, and much better results are shown by using their special waterproof finish.

THE CLEVELAND TWIST DRILL COMPANY have on exhibition their entire line of products. These are contained in a show case about 4 feet square by 9 feet high filled with samples of drills, reamers, electricians' combination bit and fishing tool. They also show a full line of their new taper shank oil tube drills and oil feeding sockets, both of which have just been placed on the market and which are meeting with universal favor.

THE AMERICAN ELECTRICAL NOVELTY AND MANUFACTURING COMPANY, of New York, show a variety of their specialties. Besides their standard line of dry batteries, etc., there is shown their latest novelty, the "Ever Ready" electric bicycle lamp. This consists of a neat case with lamp and reflector, and containing three dry cells. These are capable of giving full illumination of the lamp for from six to eight hours if used for one or one and a half hours at a time. After that period they can readily be removed and replaced by a fresh set of cells. No screws or binding posts are used, the mere act of putting the cells in place, effecting the desired connections. The absence of oil, wick, liquids, wires, etc., will make this little lamp outfit a subject of general interest to all bicyclists at the Show.

THE MONTAUK MULTIPHASE CABLE COMPANY'S booth is located at the north-eastern section of the Garden at the junction of the outer aisle, parallel with 27th street, and the outer aisle parallel with Fourth avenue, among their neighbors being the Electrical Storage Battery Company, Sprague Electric Company, the Peckham Company the Riker, the Pope Companies, etc. The exhibit is similar to that in their office at 100 Broadway. As our readers are aware, the Montauk Multiphase Cable Company have recently placed upon the market a new and revolutionary line of electrical goods—in other words, thermostatic electric cables to be used for all electrical interior work—such as electric bells, electric gas lighting, electric fire and burglar alarm, telephone and telegraph work, and even for electric lighting. We will have more to say of this exhibit in a subsequent issue when things are ship shape.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY are exhibiting a full line of instruments at the Exhibition. Among the features is a slate switchboard on which are mounted a type "K" illuminated dial and a pair of type "R" instruments. In addition to the above there are shown one of their potential indicators, an arc light voltmeter and ground detector and a ground detector for constant potential circuits. An excellent show is made by the company's line of portable instruments, represented by portable voltmeters for direct current only, and portable voltmeters for use on direct and alternating current. Besides this, they show a pair of their type "R" instruments in practical operation on a switchboard which will be used in connection with a dynamo and motor exhibition. The exhibit is in charge of Mr. Elmer P. Morris and Mr. J. F. Stevens, president of the company, is also in evidence frequently.

F. A. LaROCHE & COMPANY, New York, have brought together a representative exhibit consisting of a full line of their well known alternating current dynamos and central station equipment. Also a number of commercial switchboards for lighting installations. One of the main features of the display is a set of their new automatic independent circuit breakers. These latter are quite a novelty. All sizes of them are in action, which is accomplished by a direct current motor generator having a capacity of 5,000 amperes, which will keep the various sized circuit breakers in constant operation. The exhibit also contains the LaRoche system of arc lighting, converters, step-up and step-down; also some of their arc lamps of antique design. The exhibit also contains a full line of copper switches, and the LaRoche automatic quick break switches, a decided novelty in the switch line. Besides these there are shown a number of new automatic self-locking switches, which are now extensively used in big work in New York City.

J. P. WILLIAMS, general agent for the Paragon Ironclad Electric Motor, 39-41 Cortlandt street, New York, has constructed a pyramid of fan motors, 100 in number, all running, power motors up to 1 h. p. and all styles of ceiling and wall fans, as well as unique novelties in the electrical line.

THE CARD ELECTRIC COMPANY, of Mansfield, O., have in operation a 25 h. p. "S" type 110 volt motor; a 3 h. p. "E" type 110 volt motor; and a 12½ k. w. "E" type 112 volt dynamo. These machines are equipped with the necessary apparatus for successful operation, consisting of the Card automatic safety and limit switch for the motors and field regulating rheostat for the dynamo. The exhibit is under the management of the company's Eastern office in charge of the genial Mr. Elmer P. Morris, New York City.

ELMER P. MORRIS is representing a host of well known companies, including the following: Card Electric Company, dynamos and motors; Keystone Electrical Instrument Co., Kosmic Oil Filter Co., Highland Electrical Chemical Co., Soldering paste; Garton-Daniels Electric Co., lightning arresters; Simonds Mfg. Co., gears and pinions; Pittsburg Steel Trolley Pole Co., trolley poles. Besides these Mr. Morris exhibits electric railway supplies, iron and wooden poles, protected rail bonds, and car couplings. Mr. Phipps, of the Adams-Bagnall Electric Co., will assist in looking out for their interests and Mr. J. M. Holloway, of the Warren Electric and Specialty Co., will see to the display of Warren incandescent lamps.

THE WARD LEONARD ELECTRIC COMPANY are exhibiting various styles of their automatic magnetic circuit breakers in sizes from a few amperes up to the 2,000 amperes size. They also exhibit a variety of styles of automatic rheostats. A specially interesting feature of their exhibit is a new type of underload and overload rheostat which is known as the "SK" type, and which has many novel and valuable features. The compact size and simplicity of this automatic and its reliability in action will command general attention among the visitors in the trade. The Ward Leonard Company also exhibit various forms of the well known Carpenter enamel field rheostats, also a large variety of the porcelain lined outlet boxes, and switch boxes, etc., which have become standard for recent high grade wiring installations in New York City. A novel and very neat style of rheostat for small ventilating fans will attract a great deal of attention on account of its compactness and cheapness.

THE MANHATTAN ELECTRIC STORAGE BATTERY COMPANY exhibit a striking novelty in the shape of their "Liberty Electric Lamp." This is an electric night light, containing a small clock in the base of a miniature statue of Liberty. Inside of the base is a chloride accumulator having a capacity of from 5 to 6 ampere hours. By a turn of a knurled ring the light can be turned on at any hour of the night when required. This handy little beacon does away with the burning of a small gas flame all night. The reflector is so adjusted that it can be turned in any direction, also to throw the light down on the clock. The little stand is an ornament as well, and can be used for a banquet lamp by removing the reflector. Using it judiciously the battery will last a month on a single charge. An extra battery is furnished with each outfit. The lamp is an exact model of the Statue of Liberty and is made in the latest shades, green and gold, brown and gold, all bronze, all gold. Mr. B. B. Hoffmann is in charge of this exhibit.

THE AMERICAN MUTOSCOPE COMPANY have an exhibit of mutoscopes, showing moving pictures of scientific, comic and war subjects. Among these are a steam shovel, horseless carriage, etc. Some of the new war subjects of interest are as follows: "The Wreck of the Maine," which is a panoramic view of the wreck, showing the divers at work on the sunken vessel; "General Lee," leaving the Hotel Inglaterra, Havana, Cuba; "Captain Sigsbee," the Captain of the ill-fated "Maine" is shown descending the steps at the Capitol in Washington; the "Dupont," torpedo boat; "Maine" and "Iowa," battleships in Brooklyn Navy Yard; "Vizcaya," Spanish Cruiser, and many other interesting subjects are exhibited. Among the scientific subjects there is the "Ten-Inch Gun" at Sandy Hook. This immense gun, weighing 67,000 pounds, is seen to rise in the air, discharge its projectile and sink behind the fortifications. At the moment of the explosion, "the cone of vapor" is shown that follows the projectile out of the muzzle, about which there has been so much dispute in ordnance circles. The marks of the rifling are shown clearly in the smoke. The American Mutoscope Company will change the subjects daily, thus enabling daily patrons to see all views of interest to date.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., show a complete economizer of suitable size for 150 h. p. boiler, erected with sectional asbestos covers and scrapers for removing the soot, running as in actual service. Also sections of headers and pipes showing various methods of making joints, and working model with blue prints and lithographs of installations in several prominent power houses in New York and vicinity. The exhibition is in charge of Mr. Wm. Downs, M. E., the company's New York representative; Mr. A. H. Blackburn, general manager; and Mr. P. J. Challen, from the works, is also in attendance.

HARRISON SAFETY BOILER WORKS.—This company's working exhibit consists of a 300 h. p. standard Cochrane feed water heater and purifier, complete with usual fittings, and a 7-inch horizontal Cochrane steam separator, new high pressure pattern, complete with companion flanges, gauge glass and fittings and drip valve. These are used in connection with the exhibition steam equipment.

The company's floor exhibit consists of a 350 h. p. Cochrane feed water heater and purifier, having the new style of cleaning doors and removable trays. The back plate of the heater is removed to show the interior construction, the manner in which the steam and water are brought together; the arrangement for controlling the cold water supply; the over-flow connection; the vented hood to protect the pump suction opening; and the provision made for carrying a large body of filtering material, such as coke, the blow-off opening, etc.

Here is also shown a 6-inch horizontal Cochrane steam separator, new high pressure pattern, complete with companion flanges, gauge glass and fittings and drip valve; and finally a 6-inch vertical Cochrane steam separator, complete.

ASHCROFT MANUFACTURING COMPANY.—This company's exhibit is included in that of their New York agents, Messrs. Manning, Maxwell & Moore. It consists of a full line of pressure and vacuum gauges, farm engine gauges, with new auxiliary spring attachment, locomotive gauges, locomotive double spring gauges, compound pressure and vacuum gauges, combination water pressure gauges, ammonia gauges, altitude gauges, test gauges, Westinghouse air brake gauges. Besides these are the company's locomotive and marine clocks, square and round revolution counters, screw test pump and gauge, inspectors' test pump and gauge, gas fitters' proving pump, Edson recording gauges, Kayser automatic safety water gauge, Ashcroft malleable iron pipe stocks, with solid dies, genuine Packer sleeve and boiler ratchets, Moscrop speed recorder, Tabor indicators for steam engines and gas engines, and the Coffin averaging instrument.

The boilers supplying the steam for the Exhibition are fitted with Ashcroft steam gauges. These goods are shown in a very attractive manner, in section and in all sizes.

THE MONARCH MANUFACTURING COMPANY have one of the most interesting exhibits to be seen in the entire Exposition, consisting of various applications of the Monarch engine stops and speed limits. One pair of these apparatus is mounted upon a table in connection with an engine throttle valve. The engine stop is connected so that by pressing any of the several buttons placed at convenient points, the valve is closed inside of five seconds. In order to make this demonstration very plain to visitors a church organ pipe is mounted on top of the valve, while below, the valve is connected with piping to a Sturtevant blower operated by an electric motor. One can readily see by this arrangement that when the fan is running and the engine stop valve is open, a note is sounded from the organ pipe, but the moment the valve is closed, this sound ceases, thus illustrating the effectiveness of the apparatus in a striking manner. The Monarch speed limit is operated direct from a second electric motor, the speed of which is controlled by a rheostat. A tachometer is also connected with the speed limit, so that the exact speed of the apparatus can be read off by the visitors. When running at a certain predetermined speed the speed limit has no effect upon the engine throttle valve, but the moment this limit of speed is exceeded—which is accomplished by moving the lever on the rheostat—the organ pipe is silenced in precisely the same way it would be, were any of the several buttons pushed. This makes a very interesting exhibit for steam engine users and the working of the apparatus is so easily shown to them that they can see and appreciate in a moment just what the Monarch can accomplish. The exhibit is under the management of Mr. Albert A. Cary, the company's business manager.

THE ELECTRIC VEHICLE COMPANY will have one of their new electric hansoms on exhibition as soon as completed, which will be about the 10th of the month. They are also making preparations for electric cab service for patrons of the Exposition.

THE NEW BRITAIN MACHINE COMPANY are making their exhibit of Case engines in connection with those of the Sprague Electric Company and the C & C Electric Company. The first engine, their 5D size 25 h. p. at 550 r. p. m., will be connected direct with the Lundell generator, probably of 15 k. w. capacity. The second, their No. 4 engine, 8 h. p. at 650 turns, connected to a C & C generator of 5 k. w.

THE DIESEL MOTOR CO. OF AMERICA exhibit the first Diesel Motor ever shown in this country. It is 20 h. p., the actual brake power, and will be run on petroleum. It is shown here only for exhibition purposes, as there will be no time and room for tests as to its economy under variable loads. These will be made after the close of the exhibition in a location already chosen for the motor, near their office in this city.

THE CONSOLIDATED SAFETY VALVE COMPANY, included in the exhibit of Manning, Maxwell & Moore, embraces the well known Richardson-Ashcroft solid nickel-seated pop safety valve; Consolidated brass-seated pop safety valve; Richardson-Ashcroft Board of Trade marine valve; Consolidated encased locomotive pop safety valve; Consolidated encased locomotive pop safety valve, with muffler attached; Consolidated portable farm engine, hoisting engine, steam fire engine, and steam launch pop safety valve; Consolidated side outlet pop safety valve; Blacknall patent relief valve for locomotives; Richardson patent shifting valve; and the Richardson patent water relief valve.

The boilers supplying the steam for the Exhibition are fitted with Consolidated safety valves. These goods are shown in a very attractive manner, in section and in all sizes.

SPRAGUE ELECTRIC COMPANY.—It would take a good deal of space to describe in detail this company's exhibit, and in this short preliminary notice we can give only brief mention of the nature and variety of the exhibits displayed within the Sprague Company's space. There is one direct connected lighting plant with a Case engine, six-pole generator, 25 h. p. frame; special Lundell power motors in size from ¼ to 10 h. p.; six-pole Lundell motors of 15 and 40 h. p.; 18 and 60-inch exhaust fan outfits with spherical motors, in operation; printing press in operation with Lundell slow speed direct connected motor; an organ with Lundell blowing outfit. This is in operation and played regularly by an organist.

An interesting exhibit is an automobile motor of the London cab type with Lundell controller, in operation. A Quimby screw pump, ½ h. p., operated by a medium speed Lundell motor; a dental outfit operated with high speed Lundell motor. Then there is a complete line of Lundell ceiling fans, electrolier and column fans, all in operation; one 40 h. p. armature with form wound conductors in 148 sections; a 2 h. p. London cab double wound armature complete. Of course, a general display of interior conduit is not wanting.

The exhibit of Sprague electric elevators shows an automatic house elevator machine with five "up" and "down" buttons, operating a dummy door, lock and switch. A tandem worm gear machine with No. 4 control, in operation; a machine of the company's London type without control. This machine has two tandem worm gears and two motors arranged on opposite sides of the drum, driving the drum in parallel; a dumb waiter machine with independent floor control, in operation; a screw machine passenger elevator with No. 2 control, in operation; a multiple sheave and ball nut machine, single decker, duplicates of which are in the Astoria Hotel. A Sprague No. 2 safety device of the wedge type, the type that is now being put on all Sprague machines. In addition to the machine exhibits, will be shown photographs of all machines, and various views of the Sprague factory.

The total floor space of the Sprague exhibit is 12 x 65 feet. The exhibit is at the East end of the Garden, and may be easily identified by a 51 foot electric sign which is constantly displayed.

It is rather difficult to pick out one feature more attractive than another, but it is quite possible that the Sprague London elevator machine (the largest elevator machine ever constructed) and the automatic house elevator, in addition to the organ in operation, will attract a great deal of attention.

RIKER ELECTRIC MOTOR COMPANY, are exhibiting electric vehicles, electric motors for vehicles and special electrical apparatus.

J. H. WILLIAMS & COMPANY'S display is one of the standard and special drop forgings particularly or incidentally adapted to the electrical industries.

THE HAYDEN & DERBY MANUFACTURING COMPANY'S exhibit, under the ægis of Manning, Maxwell & Moore, the following apparatus: Metropolitan automatic injectors; Metropolitan double tube injectors; H-D Srivewell ejectors; H-D patent suction strainers; H-D noiseless water heaters.

The above goods manufactured by this company are shown by samples of all sizes and with sections showing interior views of each.

The boilers supplying steam for the Exhibition are supplied with water by a No. 14½ Metropolitan double tube injector, which is the same type of injector that supplied the boilers for the last Electrical Exhibition, held in 1896.

THE BECKMAN SYSTEM of automatic control undergrate mechanical draft is exhibited by the Kensington Engine Works, Limited, Philadelphia, Pa. This system furnishes the air supply for the two Babcock & Wilcox boilers of 520 h. p. The system consists of a steam driven fan automatically controlled by the Beckman system of valves. The air is delivered through deflecting dampers in the bridge walls under the grates, into the closed ash pits. The principal feature of the system is the automatic regulation which controls the speed of the fan by the steam pressure in the boiler. The engine running faster when the pressure falls below a fixed point, increases the supply of air under the grates and causes the fires to respond quickly to the increased demand made upon them. When the pressure rises above the desired point, the engine slows down gradually, and reduces the supply of air and the amount of steam generated. The following advantages are claimed for the Beckman system: Burning cheaper grades of fuel; increased capacity; increased efficiency; reduction of repairs; complete regulation.

J. JONES & SON, of New York, are located at the right hand side of the Garden by the first stairway leading to the Promenade about the main floor. Against this stairway is placed a very handsome switchboard containing different switches of the Jones make, and constitutes a sample of a thoroughly up-to-date board, such as they are putting out continually. On one side is shown the Jones electric cut-off and the Jones automatic time switch and also electric time cut-off switches of their cheaper make. The right hand side is occupied by a row of their panel boards of different styles.

At the rear of the space and against the wall there is an exhibition board showing the different makes of the Jones bracket fixtures, small switches, etc., and a counter upon which are shown different electric portables manufactured by Jones & Company.

In the foreground facing the aisle is a table upon which is shown a quantity of heating apparatus, and to the right hand side there is a third table with the Jones medical battery apparatus, alarm clocks and goods of kindred description.

Over the center there is hung a new arc lamp which will be put upon the market at an early date.

THE AMERICAN WATCHMAN'S TIME DETECTOR COMPANY, of New York, exhibit their well known American watchman's time detector, which is used by the night watchmen in the Exhibition building, registering upon the machine in the company's exhibit, with stations located throughout the building. There will also be shown the company's electric time system, consisting of master clock and secondaries, a number of which clocks are used throughout the Exhibition, driven by the master clock in the exhibit; and separate from this are shown the company's electric time system for private house use, consisting of a hall clock (grandfather's clock), with chimes, as master clock, driving a series of mantel clocks, and these clocks are noiseless, moving the hands at intervals of ten seconds. This is the same system which the company are putting in at the Waldorf-Astoria, connecting 700 secondary clocks to one master clock, making, when completed, the largest clock plant in the world, as well as the largest clock order ever placed, except one that is slightly larger, also captured by the company. Besides these there is shown their street post clocks in the same circuit with other clocks; school program clocks; three different varieties of time recorder for employees, all mechanical. Also an interior telephone system and fire alarm system for hotels, isolated plants and factories.

THE BOSTON BLOWER COMPANY'S exhibit consists of a 90-inch top horizontal, full housing exhauster, with a direct connected 6 x 6 inch vertical engine. The machine is to be used in connection with the Kensington Engine Works Beckman System of forced draft for furnishing blast under Babcock & Wilcox boilers.

H. B. KIRKLAND is displaying quick break switches and arc cut-outs manufactured by the Hope Electric Appliance Company, of Providence, R. I., the circuit breakers and flush switches manufactured by the Cutter Electrical and Manufacturing Company, of Philadelphia, the rheostats made by Mr. Charles Wirt, of Philadelphia, and the conduits made by the American Circular Loom Company and the Boston Electroduct Company.

KEUFFEL & ESSER COMPANY'S exhibit consists of drawing materials and surveying instruments. Of the former they have, besides drawing instruments proper, drawing papers, blue print papers, etc., a specially interesting collection of measuring instruments which are largely used by the electrical professions, that is, slide rules, calculating instruments, and protractors. At the last Exposition their exhibit commanded considerable interest, and undoubtedly will this time also.

THE AMERICAN ELECTRICAL AND MAINTENANCE CO.'S exhibit consists of methods of repairs for emergency calls, and brushes and extensions manufactured by them; also the patent adjustable turning tool, for turning down commutators without removing them from the fields. This turning tool is now on sale, heretofore only having been on loan or hire by the patentee. They have now made arrangements to manufacture and sell the same.

THE K & W COMPANY make an excellent exhibit consisting of their standard incandescent lamps, together with street series and miniature and decorative lamps. They also show their absolute cut-out hanger boards, spark arrester, K & W dynamo brushes, fan motors and commutator compound. They also have an illuminated sign made of miniature lamps in series, giving name of company and name of lamp. Mr. C. Houliston, of their New York office, is on hand to show their goods and welcome their customers.

THE BOSSERT ELECTRIC CONSTRUCTION CO. are showing a complete line of steel drawn outlet and switch boxes, representing the latest improvement in wall boxes as they are constructed entirely of one piece of wrought steel, being absolutely indestructible and thoroughly fireproof. They also exhibit carious types of steel clad self-contained main junction and distribution boxes. This type of box is designed especially to meet the objection of the underwriters and electrical engineers generally to a combustible wooden box enclosing a panel board. They are thoroughly fireproof and are designed for any number or arrangement of circuits, with or without switches.

THE ZIMDARS & HUNT exhibit consists of their electric light and power specialties, such as knife switches; panel, feeder and connection boards; automatic switches and motor starters; connections; bar work; lugs, etc. All types of the Zimdars & Hunt "all copper" knife switch in single, double and quick break are shown, together with the drawn copper back connections lately introduced by them. Three types of their improved voltmeter and galvanometer switches are also exhibited and prove interesting to numerous visitors on account of the many novel features they embody.

The panel and feeder board exhibit is a marvel in showing the very latest and most approved practice in this line. All the standard types and many of the special ones are shown mounted on a variety of marbleized slates and marbles. The effort has been to make this the most complete exhibit of feeder and panel boards ever attempted. All types of the well known Zimdars & Hunt automatic switches and motor starters are on exhibition and a new and desirable type of the automatic motor starter is here shown for the first time, and receives considerable attention. Among the many articles of merit exhibited should be mentioned a new and serviceable removable wall plug and receptacle, here shown for the first time. This device, it is believed, answers the long felt and often expressed want for a plug that sets flush with the wall when inserted in its place, thereby allowing the door to be kept closed at all times. Besides the above, a variety of other devices, too numerous to mention, are shown.

A novel feature of the exhibit is a complete bar copper railing at the front of the booth representing switchboard bar work.

THE NOWOTNY ELECTRIC CO. make a representative display of their well known products.

THE VACUUM OIL CO., Rochester, N. Y., are making an exhibit of lubricating oils such as are supplied by them for electrical machinery in all parts of the world.

THE PARTRIDGE CARBON CO. have their self lubricating motor and generator brushes on exhibition and Mr. James Partridge is looking out for their interests.

THE FISCHER FOUNDRY AND MACHINE COMPANY have a tandem compound, double valve, centre crank, self-oiling, automatic engine, direct connected to an Onondaga dynamo. This engine is of about 10 h. p.

THE NILES TOOL WORKS CO. exhibit at the Electrical Exhibition two pyramids of the all wrought steel pulley, one of which consists entirely of pulleys with faces over 8", all provided with the new rim clamp, which they have just applied to their pulleys.

THE ONONDAGA DYNAMO CO. have on exhibition a 75 kilowatt generator direct connected to a tandem compound Fischer engine. The generator is fitted with reacted carbon brushes. The electrical and mechanical construction of the generator is said to be of the latest improved pattern of dynamo construction.

THE R. THOMAS & SONS CO.'S exhibit consists of a liberal display of high voltage glaze filled insulators. They also will have their testing apparatus in place in the booth showing the manner in which the insulators are tested, and a small press and die showing the process of making porcelains by die work.

PERU ELECTRIC MFG. CO. are found exhibiting a full line of Peru specialties, such as "Peru" style branches and mains, Sawyer-Man branches and mains, Edison style blocks, "Peru" multiple tablet boards, transformer fuse blocks, all sizes and styles of insulators, cleats and tubes and also Laclede and Hercules batteries.

THE O. S. PLATT MFG. CO.'S exhibit consists of double pole snap switches from 5 to 100 ampere capacity. Flush switches, flush lock switches, double and single pole push button switches, 3 pole and 500 volt switches, knife switches for motors and lighting, from the "Baby" size to 1,000 amperes. The exhibit will be in charge of Messrs. Wood and Shaw.

THE BULLOCK ELECTRIC MFG. CO. make an exhibit of four different types of their apparatus, comprising the following: One 25 kilowatt engine type multipolar generator; one 25 kilowatt belted multipolar generator; one 10 h. p. enclosed ceiling motor, and one 7½ h. p. moderate speed belted motor. There is other apparatus of this company installed in connection with certain exhibits.

THE EDDY ELECTRIC MFG. CO. are represented by H. B. Coho & Co., and their exhibit consists of their new six pole machines arranged for direct connection, their new double voltage plater, new line shaft motor, and some of their standard apparatus. They expect to operate a 75 kilowatt Warren Alternator, working 1,100 and 100 volts off the same machine, and driven by an Eddy motor.

THE JOHN STEPHENSON COMPANY are making an interesting exhibit in which is shown a model car one-quarter actual size; being a full working model of the standard car used by the Metropolitan Street Railway Company of New York, on their underground electric system. Besides this there is a standard car in operation; also showing the standard car used by the Metropolitan Street Railway Company of New York on their underground electric system.

THE JOHN THOMSON PRESS CO. are exhibiting their half medium Style 2 press. Its trade name is "Colt's Armory" press, and built for them by the Colt's Arms Co., of Hartford, Conn., being designed by Mr. John Thomson. This press is used by practically all of the leading concerns in the United States and Great Britain, in the production of the finest grades of half tone and color printing. At the Exposition the press is shown direct connected to a Bullock motor.

THE BABCOCK & WILCOX CO. have furnished two boilers of 265 h. p. of their complete forged steel construction built for 200 pounds working pressure. These boilers are to supply steam for the Exhibition. They are part of a plant of 16,000 h. p. sold to the Metropolitan Street Railway Company for the new 96th street power house, and are furnished by the Babcock & Wilcox Company for use during the Exhibition by special permission of the Metropolitan Street Railway Company.

THE NEW YORK SAFETY STEAM POWER CO.'S exhibit comprises a vertical automatic cut-off engine direct connected to a Fort Wayne generator. This is one of their latest designs of vertical engines especially built for electrical work and heavy duty.

PORTER & REMSEN'S exhibit comprises a 125 h. p. Fischer, four-valve, tandem compound, automatic, self-oiling, high speed engine, direct connected to a 75 kilowatt Onondaga dynamo. The size of the engine is 9½x15x12 inches, running at a speed of 275 r. p. m.

THE EXCELSIOR ELECTRIC CO. have a very complete exhibit, including arc generators, arc motors, their latest type arc lamp, rotary transformers, single, two and three phase. Single phase synchronous motors, an Otis elevator driven by alternating current, and a line of direct connected and belt driven generators. Their exhibit is in charge of Mr. G. Warner and Mr. H. Hochhausen.

HENRY R. WORTHINGTON has 1,000 square feet in the centre of the Electrical Exposition, where are exhibited a number of different designs of small electric pumps suitable for office buildings and apartments, together with latest designs of automatic rheostats, controllers, and other electrical apparatus which pertain to electrical pumping. They also show about ten different types of larger electrical pumps, combined with electric motors and suitable for hydraulic elevator service, mine service, water work supply, irrigation, fire protection, boiler feed, etc. Among these is an automatically controlled worm geared elevator pump, driven by a 50 h. p. General Electric motor, and also one of their standard horizontal triplex electric mine pumps, driven by a 75 h. p. motor and capable of operating against 1,000 lbs. to the square inch. Their exhibit also includes a collection of framed drawings, showing different installations that have been made by this company which illustrate the most modern improvements in electro-hydraulic pump service.

THE POPE MANUFACTURING CO. have on exhibition representative vehicles of their product, including one of their single seated, Mark III, and one of their double-seated, Mark IV, Columbia motor carriages. It is also their intention to have apparatus in their space illustrative of the simple method of charging electric vehicles. In order to make it possible to afford to those interested an opportunity to test in actual service one of their carriages, it is their plan to have stationed at a point conveniently situated in regard to the Garden, a vehicle which can be employed for riding in adjacent streets.

THE NEW YORK CAR WHEEL WORKS are making an exhibit of "machined" chilled wheels mounted on special cold rolled steel axles of the type in use under all the electric tramways of this country. They have furnished some 10,000 of these axles for the electric tramways in the East in the past ten years, with a case of breakage in service yet to be reported. Another special feature is their interurban wheel, designed for use under electric tramways that run beyond the city limits and attain high speeds after leaving them. The wheel is of the single plate or disc pattern and the object of it is to take up more uniformly the heat generated by the application of the brakes at such high speed.

THE FORT WAYNE ELECTRIC CORPORATION have on the lower floor one 75 kilowatt direct current dynamo direct connected to a New York safety engine. This is one of their latest and most improved type. On the main floor they will have on exhibition operated by motor one 37½ kilowatt alternator, eight or ten motors of various sizes, a quantity of transformers, a quantity of arc lamps of all styles and finishes—long-burning, ordinary arc, enclosed arcs; all styles of globes; a direct coupled 100 light arc machine to a 15 h. p. motor with their latest and most improved automatic regulator, latest design of switchboards, instruments, meters, etc.

WILLIAM S. HAINES COMPANY'S display consists of "Heintz" steam traps, of the standard sizes, floating thermometers for manufacturing purposes, thermo regulators, pressure regulators, and a new practical thermometer, the figures on which being placed on a dial 3½ ft. in diameter, are capable of being read at a distance of 100 ft. with ease. This thermometer is on the "Heintz" principle, and is said to be absolutely correct. They also exhibit the "Heintz" Naval Alarm, which is adjusted to indicate the exact temperature in one part of the vessel at another part situated possibly several hundred feet distant. It is adjusted so as to ring a bell when the temperature in any of the apartments controlled reaches a certain point.

L. KATZENSTEIN & CO. make an exhibit consisting of their metallic packing for piston rods and valve stem stuffing box for steam engines, pumps, ammonia compressors, etc. Flexible tubular metallic packing for slip joints on steam pipes, improved slip joints, and metallic gaskets for all kinds of flanges. Mr. Katzenstein is one of the oldest manufacturers of metallic packing of all kinds.

MACHADO & ROLLER are exhibiting a full set of portable and switchboard, direct and alternating current Whitney and Hoyt instruments; a full line A. E. G. incandescent lamps; one or two exhibition switchboards made by W. S. Hill Electric Co.; small collection of special and standard Perfection dynamo brushes made by Ohio Electrical Specialty & Manufacturing Company; some sample elements of storage battery made by the Ohio Storage Battery Co., and some sample carbons for enclosed arc lamps made by F. Hardmuth & Co.

THE NONPAREIL CORK MANUFACTURING CO. is on hand with a full line of their insulations for rails, wires, etc.; sectional insulating coverings for steam, refrigerator and water pipes; block and plastic insulating coverings for boilers, heaters, tanks, kettles, flues, etc.; sheet cork insulation for heat, cold, sound and vibration in cold storage and all refrigerated rooms, floors and walls; boiler room ceilings, high speed engine and heavy machinery beds, etc.; floor and wainscot tiling, friction clutch blocks. Their Nonpareil cork steam pipe and boiler covering is used throughout the Electrical Exhibition.

THE PECKHAM TRUCK COMPANY exhibit one of the 14-B short wheel base swivel trucks and one of their 14-D swing bolster maximum traction trucks. This company is also exhibiting one of its Metropolitan special high speed single trucks under the car body shown in the Stephenson Car Co.'s exhibit. Particular attention is drawn in this truck to the long spring base which is a sure preventative of oscillation and to the rigid center brace, which removes the strain of keeping the truck square with the car body. There will also be found in the Walker Co.'s exhibit one of this company's 7-B-X Excelsior trucks, showing a different arrangement of the cantilever side frame design, which is the distinguishing feature of the Peckham single trucks.

H. B. COHO & CO. represents, among other concerns at the Exposition, the Eddy Electric Mfg. Co. and the Warren Electric Mfg. Co. They will have in operation a 75 kilowatt improved Warren alternator, working 1,100 and 100 volts off the same machine, run by an Eddy direct current motor. They also represent the American Rheostat Company, Milwaukee, Wis.; Crown Woven Wire Brush Co., Salem, Mass.; Diamond Electric Company, Peoria, Ill.; Van Horne, Burger & Co., Dayton, O.; Translucent Fabric Company, Quincy, Mass.; Otis Electric Company, 38 Park row, N. J.; Marietta Mfg. Co., Marietta, Pa.; Pennsylvania Electric Company, Philadelphia, Pa. In addition to the above companies, they will exhibit a full line of switchboards, panel boards, etc.

WOOD, SHAW & CO. are representing a number of well known concerns at the Exposition, and their exhibit will include the carbon and plumbago dynamo and motor brushes of the Partridge Carbon Co.; generators and motors with rheostats and starting boxes of the Quaker City Electric Co.; switches of the snap, indicator, flush, lock and push variety, and all copper slow and quick break switches manufactured by the O. S. Platt Co., of Bridgeport; the non-arcing lightning arrester for light and power, direct and alternating circuits made by the Universal Electric Co., and A. D. French & Co. exhibits under their supervision a line of octagonal wooden poles, plain and treated for electric light and power use. Besides this the Shaw woven wire dynamo brushes are being shown.

THE WARREN ELECTRIC MFG. CO. are represented by H. B. Coho & Co., who will exhibit an improved Warren alternator of 75 kilowatt capacity, and intend to operate same with an Eddy direct current motor. This alternator is connected for double voltage, half the capacity of the machine to deliver current without the use of transformers direct to 110 volt lamps. The other half, connected up for a potential of 1,100 volts on current to be reduced by transformers. The machine is excited by a late improved Warren direct current dynamo, which is a bi-polar machine, over magnet type, and is of an entirely new design, combining many elements of extreme simplicity with exceptionally high efficiency. The alternator is operated at a speed of 800 revolutions per minute, contains no brushes, collector rings or revolving armature; the current being taken from a stationary element of the machine.

BENJ. F. KELLEY & SON exhibit connected up and running one Kelley patent improved Berryman feed water heater and purifier.

THE ARMORITE INTERIOR CONDUIT CO., Pittsburg, Pa., show a full line of their well known Armorite interior conduit, illustrating the various uses to which it is put and setting forth its many advantages.

THE BOSSERT ELECTRIC CONSTRUCTION CO., Utica, N. Y., display steel split boxes for conduit. These boxes are said to be non-breakable and light, and claimed to be the best split conduit boxes on the market.

THE BULLOCK ELECTRIC MFG. CO. are exhibiting one 25 kilowatt engine type generator, one 25 kilowatt belted generator, one 10 h. p. type "N" enclosed motor, one 7½ h. p. type "H" standard motor, and one type "T" controller. The controller is from a recent design and the 10 h. p. type "N" motor is an absolutely new design, this motor being the first turned out of this pattern. It is entirely enclosed, being dust and waterproof, and is designed for use in foundries, on cranes, pumps, etc.

THE ADAMS-BAGNALL ELECTRIC COMPANY, of Cleveland, Ohio, are exhibiting several lamps of each type that they manufacture, both in plain and ornamental finish, namely: Series differential open arc lamps for all night use for 1,200 and 2,000 c. p., series enclosed arc lamps for 2,000 and 1,200 c. p., constant current series enclosed, two in series on 200 volts, constant current series enclosed, five in series on 550 volts and constant potential enclosed for 110 volts and C. O. enclosed lamps, one across 220 volts.

THE NILES TOOL WORKS CO. exhibit one 32"x32"x12' Niles planer with two heads on the cross rail; one Niles turret borer and five-inch lathes. The planer is provided with the company's regular tangent drive running in oil and enabling the planer to be set parallel to the line shaft. The turret borer is of a style rapidly becoming popular, and is designed to turn out very economically, work previously done on the face plates of large lathes. Each of the four largest lathes has the reversing lever placed in the apron instead of the head stock, as is ordinarily done. This enables the workman to control the movement of the carriage without leaving the cutting tool.

THE EDISON MFG. CO. exhibit the following apparatus, which they manufacture: Edison fan motor for the 110 volt direct current, Edison battery motor outfits, Edison-Lalande batteries, Edison electro-medical apparatus, Edison dental motor apparatus for battery, Edison dental motor apparatus for the 110 volt direct current, Edison faradic batteries, Edison cautery transformer for the 110 volt direct current, Edison cautery transformers for the alternating current.

THE NATIONAL PHONOGRAPH CO. occupy one-half the space that has been allotted Mr. Edison, the other half being used by the Edison Manufacturing Company. They exhibit the new Edison standard phonograph, Edison "Home" phonograph, Edison spring motor phonograph, Edison battery phonograph and also a number of special nickel plated and gold plated phonographs.

MR. T. A. EDISON, JR.'S, exhibit is a strikingly attractive one. It consists of a bank of lamps about 8 x 10 feet, arranged in circles. Each circle contains a distinct type of lamp and there will be about fourteen of these circles containing an aggregate of about 900 lamps. There will be 4, 8, 10, 16, 32, and 50 c. p. lamps, plain, frosted, red, blue, amber, green, and opal, spherical, tubular and the regular pear shape lamps. The connections are so arranged that the various parts of the bank can be lighted separately, and one part of the bank is so arranged that Mr. Edison's name appears in red spherical lamps. Connected with the exhibit is a full set of instruments for measuring the efficiency of the lamps and photometric tests will be made if arrangements can be made for the necessary dark room. It is also proposed to exhibit the Edison Junior new 500 volt incandescent lamp. This will be, probably, the only 500 volt incandescent lamp ever made with one continuous filament.

BOGUS TELEPHONE REFORMERS. A couple of well-dressed men have been arrested in New York City on a charge of grand larceny. They went around alleging that they were the accredited agents of a movement to reduce telephone rates, and are said to have gathered in about $500. They used a letter purporting to come from the New York Board of Trade and Transportation.

INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents Issued April 19, 1898.

RAILWAY SIGNALING APPARATUS. H. Bezer, New Rochelle, N. Y., 602,423. Filed Aug. 22, 1893. Comprises a semaphore blade, having a landscape background adapted to make a series of continuous revolutions in a substantially vertical plane, and to assume a defined predetermined position, to indicate the condition of the track.

SIGNALING DEVICE FOR RAILWAY CARS. F. W. Diehl, Detroit, Mich., 602,434. Filed Sept. 28, 1897. A device designed to take the place of a push button.

RAILWAY SIGNAL SYSTEM AND APPARATUS. H. Bezer, New Rochelle, N. Y., 602,792. Filed Dec. 3, 1895. Semaphore signal provided with a main and a reserve battery.

Batteries, Secondary:—

INVERTIBLE FLUID BATTERY. P. R. Cunningham and C. H. Howland-Sherman, Washington, D. C., 602,616. Filed Feb. 20, 1897. Details of construction.

Conductors, Conduits and Insulators:—

INSULATED PIPE COUPLING. G. Peeples, Philadelphia, Pa., 602,564. Filed June 19, 1896. A joint comprising an upper section connected to but insulated from the gas-pipe and having notches in its lower end, a lower section having on its upper face a series of grooves registering with the notches, and means for connecting the two sections together.

BRACKET FOR INSULATORS, ETC. J. R. Fletcher, Dayton, O., 602,576. Filed Jan. 4, 1896. Comprises a head for the insulator and a blade having one flat side and two recessed sides and tapering from butt to point, adapted to be driven into a supporting surface.

Distribution:—

APPARATUS FOR REDUCING ELECTRIC CURRENTS AND VOLTAGE. A. F. Vetter, Long Island City, N. Y., 602,709. Filed Sept. 3, 1895. Combines with the supply circuit, a current reducing resistance placed in the supply circuit, a shunt, including translating devices, and means for transferring one or more of the sectional resistances in the supply circuit to the shunt circuit.

Electro-Metallurgy:—

ALUMINUM REDUCING POT AND MEANS FOR TAPPING SAME. A. Dickey, Niagara Falls, N. Y., 602,575. Filed Nov. 12, 1897. A pot provided with a taper tap-hole and a charcoal plug fitted to the taper, and means for excluding the plug from contact with air.

Measurement:

ELECTRICAL MEASURING INSTRUMENT. H. W. Sullivan, London, England, 602,527. Filed Nov. 6, 1896. Comprises an oscillating coil, a core therefor and magnets in whose field the coil oscillates, having poles with pointed extremities brought into close juxtaposition with portions of the core without interfering with the movement of the coil.

ALTERNATE CURRENT METER. C. P. Feldman, Cologne, Germany, 602,557. Filed Dec. 21, 1897. A zero adjustment for alternate current meters.

Miscellaneous:—

APPARATUS FOR LOCATING OBSTRUCTIONS IN TUBES. B. C. Batcheller, Philadelphia, Pa., 602,422. Filed Sept. 28, 1897. Consists of an apparatus for visually recording time intervals; means for co-ordinately recording sound waves, the means being connected with the tube to be tested, so that sound waves created in the tube will be visually recorded.

VALVE CONTROLLER. A. E. Colgate, New York, 602,429. Filed Sept. 19, 1896. Employs an auxiliary valve. Details of construction.

ELECTRIC CONTROLLER FOR GAS REGULATORS. W. E. H. Williams and P. Seiler, San Francisco, Cal., 602,548. Filed May 13, 1897. Comprises an inlet valve operated by a float inside the regulator, a supplemental weight adapted to be added to the float or removed therefrom by means of electromagnets being charged or discharged by electric currents.

PROCESS OF SMELTING PHOSPHORUS. C. K. Harding, Chicago, Ill., 602,747. Filed April 5, 1897. Maintains an electric arc below the surface of the material in an atmosphere of hydrogen and continuously supplies the reducing agent through the fused mass.

ELECTRICAL MUSCULAR EXERCISE. E. Sandow, London, England, 602,774. Filed Jan. 24, 1898. An apparatus provided with handles attached to elastic cords; wires attached to the handles and so united with the cords as to be capable of extending with them.

ELECTRIC FURNACE. G. G. Clark, Galveston, Tex., 602,815. Filed Feb. 3, 1897. Comprises a revoluble fusing pot having an electrical connection therewith, a carbon electrode supported above the pot, and means for automatically feeding the material inward toward the carbon electrode as the pot revolves.

Railways and Appliances:—

TROLLEY WIRE HANGER. W. A. McCallum, Cincinnati, O., 602,463. Filed Aug. 16, 1897. Consists of a holder, an insulated bolt seated therein and having a toothed upper surface; a screw-threaded cap having a corresponding inner face, the suspending end of the bolt threaded oppositely from the cap, and a compressible washer interposed between the cap and the insulated bolt.

ELECTRIC CONTACT SHOE. W. M. Brown, Johnstown, Pa., 602,495. Filed Nov. 14, 1896. Comprises a flexible contact strip, a supporting frame comprising a bar parallel to the strip, and a cushion extending from end to end between the bar and strip.

ELECTRIC RAILWAY. H. W. Libbey, Boston, Mass., 602,584. Filed Dec. 10, 1894. Closed conduit electric railway system.

TRAVELING CONTACT FOR UNDERGROUND ELECTRIC RAILWAYS. G. B. Coleman and J. W. Duggan, Washington, D. C., 602,678. Filed Nov. 2, 1897. A traveling contact having two pairs of leading wires provided with independent couplings and independently connected to the contact shoes of the device.

STREET INDICATOR. E. J. Hall, St. Louis, Mo., 602,746. Filed Nov. 3, 1897. Details of construction.

APPARATUS FOR CONTROLLING ELECTRIC MOTORS. A. J.

Stopher, London, England, 602,781. Filed Feb. 16, 1898. Designed for electric locomotives.

Switches, Cut-Outs, Etc.:—

ELECTRIC SWITCH. A. G. McPherson, Highland Park, Ill., 602,767. Filed May 1, 1897. Employed for alternately cutting out one generator or source of supply and throwing in another. Details of construction.

CLOCK CONTROLLED SWITCH. F. L. Mackey, New Castle, Pa., 602,706. Filed Nov. 10, 1897. An automatic switch, comprising a desk having locking stops spaced thereon and carrying switch points, means acting on the disc to rotate it, a pawl engaging the stops to hold the disc, fixed switch points attachable to the circuit, and means operated by a clock to momentarily lift the locking pawl.

Telephones:—

ELECTRICAL APPARATUS. H. H. Eldred, Brooklyn, N. Y., 602,-596. Filed April 4, 1896. A telephonic apparatus comprising a magneto instrument for signaling; a receiver; a signaling circuit, including the armature of the signaling instrument; a telephone circuit; a switch to cut out the receiver and transmitter from the signaling circuit, and a second switch to bring the receiver into the signaling circuit.

THE STOCK MARKET

A Firm Market.

Much of the uncertainty of the last few weeks was dissipated by the declaration of war ten days ago. The result has been a marked stiffening in prices and an advance in values all along the line. The advance in cereals has been particularly marked, and, as usually follows in such cases, its effect has been beneficial to all values. So far as the electrical industries are concerned, the large Government orders still keep the factories busy, many working nights to deliver on time. This applies not only to large apparatus, but most of the smaller supplies which go with the former. The victory at Manilla is probably the beginning of the end, and we shall probably see an early reversion to normal peace conditions.

During the week the sales of General Electric were 2,500 shares, closing at 32⅛; Western Union, 4,584 shares, closing at 76⅞; American Bell Telephone closed at 247, the same as the week previous, on sales of 585 shares.

Steel rails are selling at $20; copper, lake ingot, 12.10c.

SOCIETY & CLUB NOTES

American Institute of Electrical Engineers.

The 124th meeting of the Institute was held on Wednesday, April 27. Mr. H. Ward Leonard in the chair. About sixty members and guests were present. A paper on "An Economy Test of Central Stations" was presented by Prof. W. E. Goldsborough, of Lafayette, Ind.; also a paper on "A Novel Form of Thermo Electric Battery," by Mr. C. J. Reed, of Philadelphia, which was accompanied by experiments. The discussion was participated in by Messrs. Cox, E. P. Thompson, Mailloux, Reed, Wintringham, Steinmetz, and Mr. W. M. Mordey, of London.

At a meeting of the Executive Committee in the afternoon the following associate members were elected: Wyatt H. Allen, care H. F. Allen, 202 California street, San Francisco, Cal.; Wm. H. Fitzhugh, superintendent Bay City Electric Plant, Bay City, Mich.; John Breckenridge Fleming, mill superintendent and consulting engineer, Austin Mining Co., Austin, Nev.; Geo. J. Henry, Jr., engineer for N. Y. Branch, The Pelton Water Wheel Co., 143 Liberty street, New York City; N. S. Hopkins, assistant engineer, General Electric Co., Box 825, Schenectady, N. Y.; Robert Lindsay, general superintendent, The Cleveland Electric Illuminating Co., 717 Cuyahoga Building, Cleveland, O.; Frederick A. Muschenheim, electrical engineer, Western Electric Co., 57 Bethune street, residence, 41 W. 31st street, New York City; Newton L. Schloss, consulting engineer, 39 Cortlandt street, residence, Stuart House, New York City; Clarence M. Tolman, electrical engineer, with Edw. G. Stoiber, Silverton, Colo.; Ernest Stiles Vinten, draughtsman, Walker Co., New Haven, Conn., residence, 89 Pearl street, New Haven, Conn.

The Northwestern Electrical Association.

The arrangements for the excursion meeting of the Northwestern Electrical Association are going on apace. Secretary T. R. Mercein and Mr. J. M. Hill, chairman of the Special Entertainment Committee, are now in the East in the interests of the association, and report most gratifying success.

The association has issued a number of special invitations to prominent electricians to be the guests of the association, among them Messrs. Edison, Tesla, Thomson, Brush, Stanley and Wood, and some of these have promised to attend if their engagements permit.

It is the intention not to make the excursion to Duluth a junket; on the contrary, business will be adhered to strictly. The value of the meeting will lie not only in the papers to be submitted, but in the topical discussions which have been arranged for, and in the answers to the question box. A number of experts in the various departments of the large electrical companies will be present and participate in the discussions.

PERSONAL

W. F. Osborne.

MR. W. F. OSBORNE, who for the past eight years has been the able Eastern representative of the Western Electrician, will on May 1 sever his connection with that paper and will thereafter be identified with the "National Provisioner" as business manager. This journal, which is the leading paper in its field, is published weekly. The proprietor of it is Dr. J. H. Senner, formerly Commissioner of Immigration, and also formerly editor of the "Staats Zeitung" and is a gentleman well known in the newspaper field. Mr. Osborn, who has won for himself a host of friends in the electrical fraternity, enters upon his new duties with the best wishes of all those, whose admiration he has won by his frank and courteous manner at all times. It gives us pleasure to acknowledge our indebtedness to Mr. Osborne for the numerous favors received at his hands and to wish him all possible success in his new undertaking.

Hill & Howard.

Mr. Nicholas S. Hill, Jr., having severed his connection with the city of Baltimore, as Chief Engineer of the Water Department on Monday, March 14, has associated with himself Mr. B. C. Howard, intending to engage in a general consulting business under the firm name of Hill & Howard. Mr. Howard is a graduate of the electrical department of Johns Hopkins University, and was formerly secretary and treasurer of the McCay-Howard Engineering Co., general contractors for electrical work. Mr. Hill is a graduate of the Stevens Institute of Technology in Hoboken, and has subsequently occupied the positions of mechanical engineer of the South Side Elevated Railroad in Chicago, a description of which appears in this issue; Engineer and Secretary of the Sewerage Commission of Baltimore, engineer to the Electrical Subway Commission of Baltimore, and Chief Engineer of the Water Department. They are now in the field for general engineering, including plans, specifications, reports, estimates, tests, etc., etc. They make a specialty of water works systems, electrical subways, electric light and power plants and transmission of power.

MR. THOMAS R. MERCEIN, the well known secretary of the Northwestern Electrical Association, is spending a few days in New York, looking after the interests of the association, arranging details for the coming convention and seeing his many friends in this city.

Messrs. Ford, Bacon and Davis, engineers, have removed to the Singer Building, 149 Broadway, New York.

REPORTS OF COMPANIES

General Electric Co.'s Sixth Annual Report.

We print below full abstracts from the annual report of the General Electric Co. to be submitted at the stockholders' meeting on May 10.

President Coffin's report reads as follows:

The past year witnessed a revival in business which increased rapidly in activity and volume during its latter months. A careful scrutiny of the assets of your company, other than its patents, leads to the belief that previous values were conservatively fixed, and no changes of any significance have been necessary. The patent account of the company has been kept at substantially the same amount on its books since the organization of the company. The question of a revaluation of patents is one to which consideration should be given at the proper time.

BUSINESS OF THE YEAR.

Gross earnings	$12,524,938.07	
Less expenses	10,727,692.02	
		$1,797,246.05
Interest and discount, and interest and dividends received on securities owned	389,789.16	
Less:		
Interest on debenture[1]	333,333.35	
		56,455.81
		1,853,701.86
Deduct amounts written off:		
Sundry losses and allowances for possible losses	79,220.42	
Patents and patent expenses	333,334.68	
Inventories and consignments	89,665.70	
Reserve for extensions to factory plants	250,000.00	
	752,220.80	
Less:		
Profit on securities sold and debentures canceled	130,371.31	
		621,849.49
Reduction of the deficit of previous years		$1,231,852.37

In addition to the purchase of $2,000,000 of debentures referred to in previous annual reports, your company has purchased during the year just ended $2,000,000, and the entire $4,000,000 have have been destroyed. Since the books were closed $290,000 additional have been acquired, and are now held in the treasury of the company. An increase is shown in the amount received from interest and dividends from securities owned. In anticipation of the investment in the construction and equipment of new shops, which it is estimated will cost about $500,000, the sum of $250,000 has been deducted from the profits of the past year and carried to factory reserve account.

Consolidated Balance Sheet of January 31, 1898.

Assets.			Liabilities.		
Patents and Franchises		$ 8,000,000 00	Capital Stock:		
Factory Plants		[illegible]	Common	$ 30,460,000.00	
Real Estate (other than factory plants)		[illegible]	Preferred	4,252,000.00	$ 34,712,000.00
Stocks and Bonds		[illegible]	5% Gold Coupon Debentures		6,000,000.00
Cash		[illegible]	Accrued Interest on Debentures	50,000.00	
Notes and Accounts Receivable	$ [illegible]		Accounts Payable	[illegible]	[illegible]
Work in Progress	[illegible]				
	[illegible]				
Inventories:					
Factories	$ [illegible]				
General and Local Offices	[illegible]				
Consignments	[illegible]	[illegible]			
Profit and Loss		[illegible]	Reserve for Extensions to Factory Plants		250,000.00
		$ 41,[illegible]			$ 41,776,[illegible]

At the annual meeting of the stockholders, held four years ago, the question of reducing the company's share capital in the manner prescribed by law, was referred to the directors. Since that time the matter has had the earnest attention of your board, and it is their hope that a plan will be submitted for your consideration at an early date, designed to provide for a suitable reduction of the share capital of the company, with a view to the resumption of dividends.

THE PATENT SITUATION.—The patent situation has not materially changed since the last report to the stockholders. The company has secured many important patents during the year, by inventions of its engineers and experts and by purchase.

One of the Van Depoele trolley patents which had been uniformly sustained by the courts up to last summer has been adversely passed upon by the Court of Appeals for the Second Circuit. This decision was on a motion for preliminary injunction and is not final. In view of the fact that nearly all of the railway companies in the country that would be likely to use the overhead trolley system are now electrically equipped, and that the third rail and underground conduit methods are being rapidly adopted for the important new enterprises, an adverse decision in this case will have but slight effect upon the business of your company.

The report of First Vice-President Griffin reads as follows:

I submit herewith a condensed report of the operations of the sales department for the fiscal year ending Jan. 31, 1898:

Total sales (amount billed to customers)	$12,396,093
Cost of goods sold, general expenses and taxes, including sundry losses and allowances for losses	10,896,578
Profit on sales	$1,499,515

From this profit should be deducted debenture interest, etc., as shown in the report of the second vice-president.

Our sales for 1897 are somewhat less than our sales for the previous year, while our orders are considerably in excess of the orders secured in 1896. The following figures are based on orders secured and not on sales.

Consolidated Profit and Loss Account of January 31, 1898.

Expenses.			Earnings.		
Balance January 31, 1897		$ 12,[illegible]			
Cost of Goods Sold	$ [illegible]		Sales	$ 12,396,093.49	
General Expenses, Taxes, Sundry Losses and Allowances for Losses	[illegible]	10,896,578.14	Royalties and Sundry Profits	[illegible]	$ 12,[illegible]
			Dividends and Interest received on Stocks and Bonds owned	[illegible]	
Interest on Debentures		333,333.35	Interest and Discount	[illegible]	389,789.16
			Profits on Sale of Stocks and Bonds	[illegible]	
			Discount on Debentures Purchased and Canceled	[illegible]	
Patents and Patent Expenses		333,334.68			130,371.31
Reserve for Extensions to Factory Plants		250,000.00	Balance January 31, 1898		[illegible]
		$ 24,770,[illegible]			$ 24,770,[illegible]

E. & O. E.

I. P. ORD, *Second Vice-P.*

LIGHTING DEPARTMENT.—We have received during the past year orders for 60,826 kilowatt capacity of arc and incandescent lighting machines as against orders for the year 1896 of 57,476 kilowatt capacity, an increase of 5.8 per cent.

RAILWAY DEPARTMENT.—Orders received (money value) for railway apparatus has shown an increase of 33⅓ per cent. over 1896. Orders for railway generators aggregated over 60,000 kilowatts. The average size of the railway motor has increased to 34.7 h. p., while the average railway generator for 1897 was 484.3 h. p., as against 356.3 h. p. in 1896.

POWER AND MINING DEPARTMENT.—Orders for direct current and induction motors aggregated 19,531 h. p. as against 15,171 h. p. in 1896. Orders for multiphase generators aggregated 49,902 h. p. as against 25,007 h. p. in 1896. Total transmission lines installed in connection with G. E. apparatus, 326 miles as against 232 miles in 1896. The orders for 1897 were 60 per cent. over those for 1896.

SUPPLY DEPARTMENT.—The supply department has handled 114,229 separate orders during the year, or 43 for each working hour. The "orders received" in 1897 exceeded by 20 per cent. the "orders received" in 1896. The supply stocks carried at our local offices have been decreased about 7 per cent. during the year, and of the present total, 90 per cent. consists of active supplies, a great improvement over previous years.

The following are some of the principal articles handled by the supply department:

Wattmeters.—Total number ordered during the year 36,874, an increase of 42 per cent. over 1896.

Measuring Instruments.—Total number ordered during the year 3,369, an increase of 38 per cent. over 1896.

[1] On $8,000,000 for four months and on $6,000,000 for eight months.

Transformers.—Total number ordered during the year 11,499, an increase of 36 per cent. over 1896.

Arc Lamps.—Total number ordered during the year 24,158, an increase of 75 per cent. over 1896.

Sockets and Receptacles.—Total number ordered during the year 2,357,629, an increase of 36 per cent. over 1896.

FOREIGN DEPARTMENT.—The orders of the foreign department have shown a gratifying increase over the orders for 1896. Several notable contracts have been placed with us by our foreign companies—the equipment of the Central London Underground Railway, and the equipment of the street railways in several European cities.

INCANDESCENT LAMP SALES.—The incandescent lamp orders for the year aggregated 6,857,239 of which 6,706,624 were shipped. This is an increase of about 10 per cent. over the year 1896.

The report of Third Vice-President Rice is devoted to the manufacturing department and to the increase in manufacturing facilities. Mention is made of the erection of a new foundry having 94,000 square feet of floor space: also an addition of 36,000 square feet to the testing and assembling departments.

Vice-President Rice also enumerates a number of large plants installed or contracted for. There are at present G. E. transmission plants aggregating 100,000 h p., among them twenty installations operating at over 10,000 volts transmitting a total of over 50,000 h. p. to distances varying from ten to forty miles.

Following is Second Vice-President Ord's report:

ASSETS.

PATENTS AND FRANCHISES.—During the year there was expended for acquiring new patents and in patent litigation, $333,334.68, all of which has been written off to profit and loss; leaving the patents, franchises, good will, etc., of the company standing unchanged at $8,000,000.

FACTORY PLANTS.—The changes in this account since the last annual report is as follows:

	Jan. 31, 1897.	Jan. 31, 1898.
Book value of Schenectady plant....	$2,157,000.90	$2,300,000.90
Book value of Lynn plant..........	993,000.80	900,000.80
Book value of Harrison plant........	250,000.30	200,000.30
Totals	$3,400,002.00	$3,400,002.00

STOCKS AND BONDS.—No changes of last year's figures have been made in the book valuations of stocks and bonds. Those having a market value are carried under the price of reported sales. The book value of those not readily salable was fixed on January 31, 1897, after careful examination of their worth. I believe the actual present aggregate value of all these securities is equal to the total amount at which they stand on the books, viz., $7,455,872.96. Stocks and bonds of subsidiary companies were sold to the value of $1,038,054.80.

CASH.—The policy of the previous three years has been adhered to and sales maintained on a basis of cash or short credit to desirable customers. None of the money realized from the sale of assets was required for the current business of the company during the year.

NOTES AND ACCOUNTS RECEIVABLE.—This account represents the total amounts now due the company by its customers.

They appear in the balance sheet at an estimated realizable value (i. e., their face, less a total allowance of $662,614.66 for possible losses) which I believe to be a fair one.

INVENTORIES.—The inventories of the factories showed an excess over book value of $275,097.72, which is not taken as a part of the year's profit, but is retained as a reserve. All other inventories showed a shrinkage from book value of $79,238.39, which has been written off as a loss for the year. Goods are taken in and out of local office inventories at factory cost at the time being. The bulk of the above shrinkage is due to factory costs at January 31, 1898, being lower than at January 31, 1897, and to writing down the book value of slow selling apparatus and other personal property.

The net book value of consignments is $52,734.79.

LIABILITIES.

The company has no notes payable, nor is any paper bearing the company's indorsement of guaranty under discount. All purchases have been paid for in cash. It has not been necessary to borrow money, nor has the company's credit been used during the year either by issuing notes, indorsing customers' paper for discount or lending its name in any way.

DEBENTURES.—During the year the company has purchased and canceled $2,000,000 of its own 5 per cent. gold coupon debentures due June 1, 1922, at an average of 99.30 per cent.

ACCRUED INTEREST ON DEBENTURES.—This account, as its name implies, is the full amount of 5 per cent. interest accrued to January 31, 1898, on the company's $6,000,000 outstanding debentures.

ACCOUNTS PAYABLE.—This account includes all unpaid audited indebtedness. At the close of business on January 31, 1898, there were no unpaid vouchers on hand.

RESERVE FOR EXTENSIONS TO FACTORY PLANTS.—This account represents $250,000 set aside, from the profits of the business of the past year, toward the cost of erecting and equipping at the Schenectady plant an iron foundry and a machine shop which are estimated to cost about $500,000.

The correctness of the financial statements is attested by Messrs. Patterson & Corwin, certified public accountants.

TRADE NOTES & NOVELTIES

Kinloch Telephone Co., St. Louis.

The Kinloch Telephone Co., St. Louis, are making rapid headway with the equipment of their great plant. As a result, they expect to be in a position in a comparatively short time to afford St. Louisans an independent telephone service. The latest of the large contracts which the company have entered into in this connection is for their annual wants in galvanic batteries and their respective parts. This contract, which was awarded to the Phoenix Carbon Manufacturing Co., of St. Louis, is said to be the largest of its kind ever placed, and was sharply competed for by carbon manufacturers from all over the country. It was given the local company, for their well-known Phoenix No. 1 carbon cup cell, after a test by experts.

Central Electric Company's New Quarters.

A visit to this company's new quarters, No. 264-266-268 Fifth avenue, Chicago, will well repay those in the electrical trade. The first thing which impresses one on entering the building is its enormous size, the floor space being 80 ft. front by 140 ft. deep, extending to a large and commodious alley, which facilitates the handling of goods from wagons and drays. The front part of the store is divided into five handsome office suites, finished in quartered oak. Back of these offices, arranged in convenient manner are shelves, containing a large stock of general supplies, such as lamps, shades, Okonite wire, porcelain goods, railway supplies, electrical glassware, etc. On one side of the building are specially built fireproof vaults for stationery and advertising matter.

The large basement has a number of freight elevators for the quick handling of goods, cement floored, light and airy, and is of the same size as the store above. It is to be used for the storage of heavy wire, pins, brackets, cross-arms, etc. In short, the whole establishment has been arranged for the carrying of a very large stock of electrical supplies, for their convenience of handling and for beauty as well. The Central Electric Co. ranks among the largest supply houses in the world, and The Engineer wishes them continued prosperity in their new quarters.

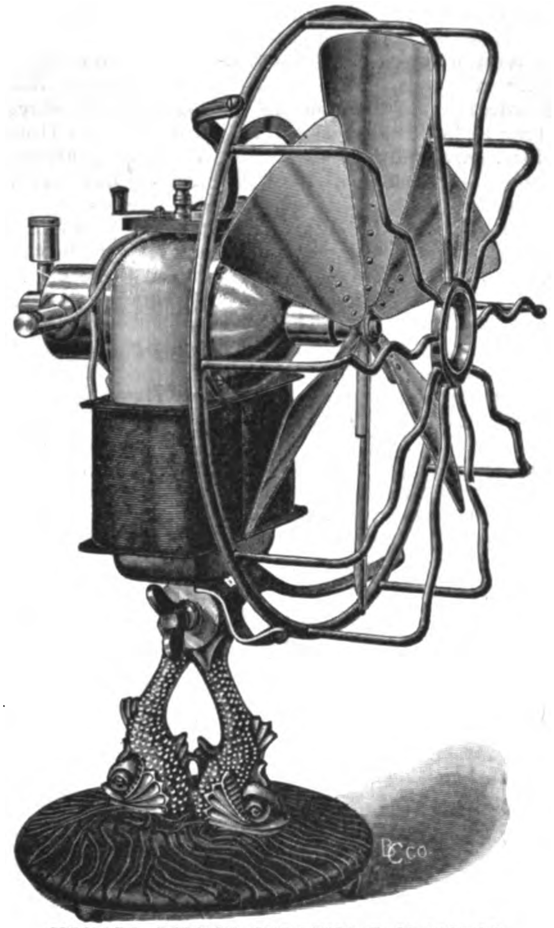
A New Haven Electrical Bridge.

The Berlin Iron Bridge Company, of East Berlin, Conn., have just completed at Grand avenue, New Haven, Conn., a steel bridge 427 feet in length, 52 feet in width, with one roadway and two sidewalks. The approaches on the bridge consist of two deck plate-girders. The draw span is 200 feet in length and is operated by electricity; the same means being employed for lighting the bridge throughout. The bridge is of very heavy construction, the roadway being paved with vitrified brick adapted to the heavy city traffic.

Noxall Fan and Power Motors.

THE Noxall 1898 motors, manufactured by the Vance Electric Company, 136 Liberty St., New York, have recently been placed on the market. The fan motor, illustrated below, is exceedingly graceful in outline, and nothing has been lost sight of in obtaining a perfect operating and highly efficient machine. The pole pieces are of mild steel, carefully milled and accurately fitted to steel templets, all exposed parts highly polished and nickel plated on copper. The armature is of the ironclad slotted, Pacinotti type, carefully mounted on solid steel shafts with laminated annealed rusted iron discs. All conductors are carefully laid in and secured by the usual binding wires. This construction admits of the armature running with minimum air gap. All armature wires are accurately fitted to commutator bars and brazed. The commutator is made up of hard tempered copper, drop forged bars and thoroughly insulated by best India mica.

The bearing cases or bonnets of brass are firmly secured to the pole pieces on each side and wholly enclose the armature

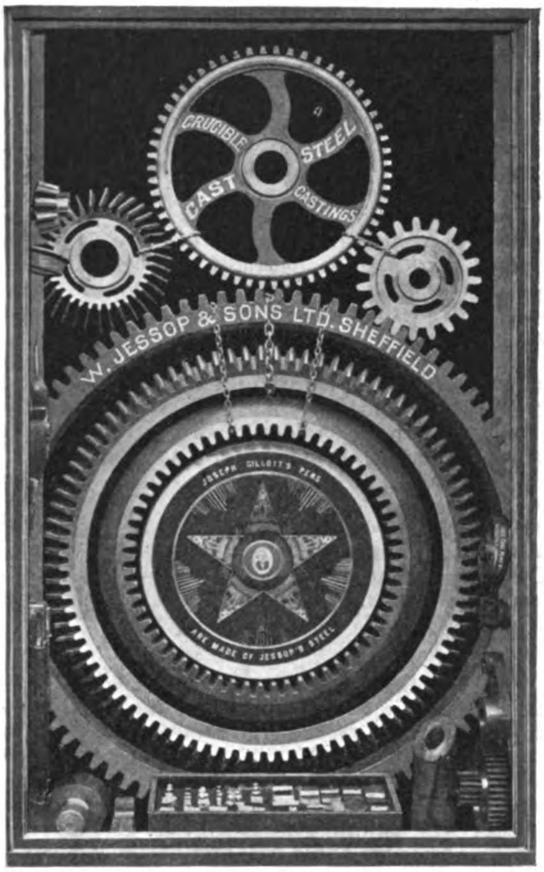


NOXALL DIRECT CURRENT FAN MOTOR.

and commutator, insuring absolute protection to the vital parts of the machine. The journals are long and are self-lubricating by small grease cups. An occasional turn of the cup, say, once a week, when first putting the fan up to run is all that is required. There is sufficient grease in the cup to last one season. The bonnet at commutator end carries the brush holders which are neat cylinders holding carbon pencils kept in contact by spring pressure. The carbon used is a special kind insuring even contact is self-lubricating and prevents sparking. The brush cylinders afford easy means of inspection and adjustment as they are screwed through the bonnet on opposite sides. The switch for giving three speeds and the terminals for receiving current connections are mounted on hard rubber on the top of the machine across pole pieces and have proven to be more handy and less liable to give trouble than when in the base. This switch gives the fan three speeds: 1,800, 1,400 and 900 revolutions per minute. Lower speeds can be furnished when desired on special order. These motors are built for direct or alternating current circuits and for any desired voltage.

A Display of Jessop's Steel.

A VERY interesting exhibit has recently been shown in the windows of William Jessop & Son, John street, New York, consisting of a tasteful arrangement of crucible steel castings, cast car and gear wheels, cutter blanks, tool steel and other products of the Jessop works. This exhibit is illustrated in the cut shown below and contains within the central gear wheel a handsome show case containing a collection of steel pens of the celebrated Gillott brand made of Jessop steel and arranged in



DISPLAY OF JESSOP STEEL PRODUCTS.

star form showing the various styles of this celebrated pen for which steel is used. The whole arrangement is well worth the inspection of those interested in metals, and is one of the brightest displays in John street.

Elkhart Transformers at Weston, O.

Oswald Bros., of Weston, O., under date of April 16 have sent the following to the Kuhlman Electric Company, makers of the new Elkhart transformers, at Elkhart, Ind.:

"We have had the 75 one light transformers purchased of you last month, installed and in circuit all night for the past fifteen days and have been watching results very carefully and must say, that so far as we can see, up to the present time they are a success. We get better efficiency than we expected and a 16 c. p. lamp operated in this way is giving better satisfaction in this town than 32 c. p. lamps are giving in surrounding towns. If we have any more installations for incandescent street lighting, we shall use nothing but the small transformers."

Roe & DeBonneville.

The above is the name of a firm recently formed by Mr. Charles J. Roe and Mr. A. A. DeBonneville, M. E. Mr. Roe has had twenty-five years' practice before the courts and Mr. DeBonneville is a mechanical engineer of twenty years' experience as well as an attorney-at-law. The combined experiences of these gentlemen eminently fit them for the preliminary examination, preparation and prosecution of applications for patents, trade-marks, etc., and also to prosecute all litigation in reference to patents, etc.

The offices of the firm are at Room 621, Bowling Green

Building, New York, and at No. 1 Montgomery St., Jersey City, N. J.

A Lighting Plant for Alaska.

The Electrical Exchange, Chicago, has just shipped a complete lighting plant to the Alaska Transportation & Mining Association, St. Michaels, Alaska. This outfit will be used to light one of the companies' steamboats plying on the Yukon. One of the Midget Upton enclosed arc lamps (for which the Exchange has recently taken the agency) will be used to light the prow of the steamer. The Exchange reports a gratifying increase of business during the month of April.

Special Applications of Westinghouse Apparatus.

Problems of special difficulty have been solved by the Westinghouse Electric and Manufacturing Company in the construction of the apparatus recently shipped for the works of the Carborundum Company, of Niagara Falls. 1,000 h. p. is supplied at voltages varying from 80 to 200. The work involves special difficulties on account of the wide range of voltage and the very large currents carried. The apparatus as designed by the Westinghouse staff is of high efficiency and power factor, unusual virtues in most of the so-called electrical machinery built for this class of service.

The Westinghouse Electric and Manufacturing Company is to supply the electrical apparatus for the new plant of the Detroit, Ypsilanti and Ann Arbor Railroad Company, consisting of four 300 h. p. generators, three boosters, switchboards, and ten car equipments, including forty 50 h. p. motors.

Niagara power is still being developed by Westinghouse apparatus. The Westinghouse Electric and Manufacturing Company has recently sold to the Niagara Falls Power Company two 500 h. p. rotary transformers, three 500 kilowatt lowering static transformers, and the complete switchboard, for operating the street railway system of North Tonawanda, N. Y., between Buffalo and Niagara Falls.

The Wood, Shaw & Co. Business Consolidation.

We take pleasure in calling attention to the fact that the business of Mr. Joseph S. Wood, electrical engineer, of 25 Park Row, and that of Mr. H. M. Shaw, manufacturers' agent, 126 Liberty street, New York city, have been merged into the firm of Wood, Shaw & Co., manufacturers, exporters and dealers in electrical specialties, with general offices at 40 Broad street, New York. The shops of the new firm are fully equipped with machinery, tools, help, etc., for turning out the highest grade of work in the quickest time possible. This consolidation places the combined business on a basis of unlimited resources and facilities for engineering, manufacturing and selling the specialties heretofore handled individually. Prompt attention and satisfaction is guaranteed on all orders intrusted to the firm.

Mica and Micanite Agency, Cleveland, O.

Eugene Munsell & Co., and the Mica Insulator Co., of New York and Chicago, last week completed arrangements with the George Worthington Co., of Cleveland, whereby they become distributors of both "Mica" and "Micanite." Their territory includes the city of Cleveland and some eight or ten of the adjoining counties.

A large stock of India and Amber "Mica," in the sheet and segments for railway motors, as well as "Micanite" plate, segments, rings, cloth, paper, etc., will be carried to supply the electrical trade in that section.

This is an important step in the right direction, and the trade in Cleveland and vicinity will appreciate the fact that this stock has been placed in the hands of so large a company, who have the facilities for making prompt delivery.

MR. GEORGE W. PATTERSON reports that on or about May 1 the two companies he represents—the American Circular Loom, Flexible Conduit and the Gordon, Law and Phœnix Batteries—will remove from 1114 to 1539 Marquette Building, Chicago, and invites all old friends and customers to come up and have a bird's-eye view of the city.

The Conduit business was never so good before, and is increasing, while the merits, and especially low prices of the Phoenix batteries, are beginning to be recognized in a very flattering manner.

Large Sales of the C & C Electric Co.

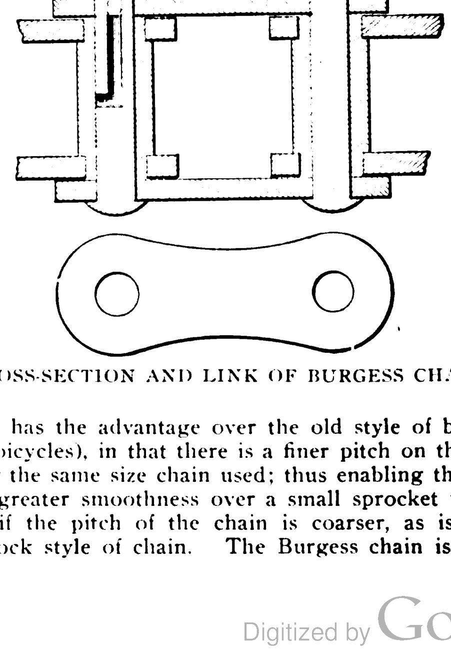
It seems that the war has not, at least up to the present time, had a very injurious effect upon the business of the principal electric manufacturing companies, and we are advised that the C. & C. Electric Company in particular are very busy. While a number of their orders during April came from the Government, orders were also very numerous from other quarters. In New York city and vicinity, while they sold as usual a very large number of small dynamos and motors, they secured an order for two 30 kilowatt direct connected generators and a 9 h. p. motor and a three panel switchboard to be installed at the Grand Union Hotel; an order for three 30 kilowatt direct connected generators to be installed in the Ward Building, No. 707 Broadway; an order from A. Trenkmann, tortoise shell manufacturer, for a 30 kilowatt belt type generator, and an order from one of our largest wholesale houses for a 100 kilowatt direct connected generator.

Their Pittsburg office, besides making a number of sales of small machines, sent in an order for a 20 kilowatt generator direct connected to the Weston engine with switchboard, to be installed for the Cambria Brewing Company, of Johnstown, Pa.; an order for three 30 kilowatt generators to be direct connected to three Weston engines and installed at the Custom House and Post office at Pittsburg. Their Mr. J. C. Lucas at Baltimore secured orders for three 30 kilowatt generators of the direct connected type to be installed at the Louisville Custom House and Post Office, besides orders for several belt type generators and motors to be installed in Washington and Baltimore; their Philadelphia office sent in their usual large number of orders for machines for Philadelphia and Eastern Pennsylvania, as well as an order from the Government for a complete lighting and power plant for Fort Delaware, consisting of a 100 h. p. boiler, two 40 h. p. Ames engines, two 30 kilowatt direct connected generators, switchboards and booster plant and everything necessary to make a complete power and lighting installation. Their Boston office as usual contributed its quota.

Their London representative, Mr. C. R. Heap, sent in orders for some ten or twelve Ironclad motors; their Chicago representatives, Messrs. Sargent & Lundy, never fail to send in frequent orders and April was no exception, as their orders covered several good sized generator and motor equipments. The company's other agents also sent in their share of orders, all of which have gone to make the month of April a very busy one for the C. & C. Electric Company.

Special Steel Chains Manufactured by the Boston Gear Works.

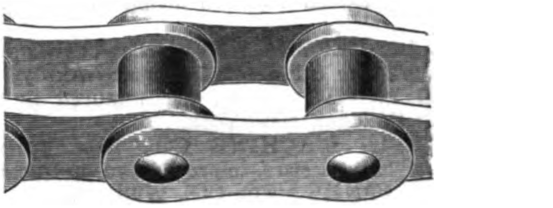
The Boston Gear Works, 31 Hartford street, Boston, Mass., Frank Burgess, proprietor, manufacturers of gear wheels, are placing upon the market a superior steel chain for which many decided advantages are claimed. One of the principal improvements which have been made in this chain, which is shown in the accompanying cuts, is the case hardening of the sleeve, which adds a great deal to the durability of the chain. The



CROSS-SECTION AND LINK OF BURGESS CHAIN.

chain also has the advantage over the old style of block chain (used on bicycles), in that there is a finer pitch on the sprocket wheels for the same size chain used; thus enabling this chain to run with greater smoothness over a small sprocket wheel than it would if the pitch of the chain is coarser, as is necessary for the block style of chain. The Burgess chain is admirably

suited for electric carriages, where it insures a saving of power and a smoothness of running. The company make a specialty



BURGESS CHAIN, FULL SIZE.

of intermittent gears, on which subject they publish a very interesting pamphlet. Details of these gears and other products of the company will be published later.

George C. Towle Manufacturing Co Chartered.

A charter has been issued to the George C. Towle Manufacturing Company to manufacture electrical machinery at Lancaster, Pa. The directors are G. C. Towle, J. E. Hubley and R. Blickenderfer, Lancaster, Pa.; G. A. Towle, Lowell, Mass., and J. P. Williams, of New York. The new company has the contract for making the Paragon fan and power motors for the season of 1898.

Large Order for the Ball Engine Co.

The New Vancouver Coal Co., Nanaimo, British Columbia, has ordered a 175 h. p. engine from the Ball Engine Co., Erie, Pa., for electric mining purposes. The Chappell Chemical Co., of Hegewisch, Ill., will have an electric light plant. A "Ball" engine furnishes the power. The American Ordnance Company, Lynn, Mass., has ordered through J. H. Houghton, Boston agent of the Ball Engine Company, Erie, Pa., a 125 h. p. engine for use in Government work. These orders speak well for the Ball Engine Co., Erie Pa., who build engines exclusively for electric purposes. The enviable reputation of the "Ball engine" has no doubt much to do with the satisfactory condition of their order book.

Northern Elec. Mfg. Co.'s New Agency.

Kohler Brothers, 1645-48 Monadnock Block, Chicago, have just taken the sales agency for the Northern Electrical Mfg. Co., of Madison, Wis., for the States of Illinois, Iowa, Missouri, Indiana, Nebraska, Kansas, Kentucky, Tennessee, Michigan, Ohio, Pennsylvania, New Jersey, Maryland, Delaware, and District of Columbia; and are now prepared to figure on all kinds of direct current electrical apparatus up to 250 kilowatts.

CATALOGUES.

The Consolidated Telephone Construction and Mfg. Co., Ltd.

A very instructive and attractive catalogue of receivers, transmitters, magneto bells and generators has just been issued by the Consolidated Telephone Construction and Manufacturing Co., Ltd., located at 186-188 Shaftesbury avenue, London, W. C. The catalogue contains numerous illustrations of all kinds of telephone and telegraph apparatus besides a number of useful electrical diagrams. The catalogue measures 9½ x 12½ inches, has a handsomely engrossed cover and in every way does justice to the excellent products turned out by the company.

General Electrical Co.'s New Fan Catalogue.

A very handsome fan motor catalogue has just been issued by the General Electric Co. illustrating their 1898 alternating and direct current fan motors. Their alternating current motors, which have been illustrated in our pages, are made for 52 and 104 volts, 60 and 125 cycles. The electrical construction of these motors has been carefully designed and thoroughly tested. The various parts are as carefully proportioned and as in larger machines, no fear of excessive wear or heating need occur when fans are operated continuously. The motors are finished in black enamel and nickel plate. The same applies to the direct current motors which are fully described and illustrated in this highly artistic and useful catalogue.

The Globe Carbon Company.

The various uses to which carbon is put for electrical work are ably set forth in a pamphlet recently issued by the Globe Carbon Co., of Ravenna, Ohio. An innumerable variety of arc light carbons are illustrated, plain as well as copper-coated. These moulded carbons have a correct mechanical finish, are electrically low in resistance, which insure a bright clear light of great steadiness, and the copper-coated carbons have just the proper copper coating to avoid the forming of copper globules. The company also manufacture Le Clanche and dry battery plates of great variety, carbon brushes and back plates and diaphragms for telephone work. They make a specialty of carbon cylinders, filament blocks, carbon flour, and are the manufacturers of the standard Fuller cell, the Hayden cell and supply the trade with chemicals and other appliances for primary batteries.

Harrison Safety Boiler Works, Philadelphia, Pa.

A very handsome and artistic catalogue describing the Cochrane heaters and elucidating the full value which can be obtained from exhaust steam for heating and purifying feed water and for heating systems, published by the Harrison Safety Boiler Works, of Germantown Junction, Philadelphia, Pa., has just reached our office. The catalogue contains, besides numerous beautiful half tone cuts, articles on "Why Feed Water Heaters Are Used," and comparisons of open and closed heaters, the Cochrane heaters, a story of steam heating and all about the Cochrane separators.

Barnes Metal Working Machinery.

A very neat catalogue has just been issued by the W. F. and John Barnes Company, of Rockford, Ill. Disk drill presses and upright drills of all kinds, screw presses, emery grinders, lathes and hand-turning tools, chucks, and every variety of machine tools are illustrated in his admirable circular and price list.

Dearborn Drug and Chemical Works, Chicago, Ill.

Two very handsome and neat booklets setting forth the advantages of boiler compounds manufactured by the Dearborn Chemical Works, have been received at this office. The handsomely engrossed cover of one of them bears the significant motto, "An ounce of prevention is better than a pound of cure," also advising users of boilers to be sure that they are right. The cover of the other booklet bears the inscription, "Inspection Brings Knowledge," and the book contains valuable data on chemical tests of water. These two booklets will be sent to any one on application.

Electric Light Supply Catalogue of the Western Electric Co.

The new Electric Light Supply catalogue which has just been issued by the Western Electric Co., New York and Chicago, is perhaps the most complete catalogue of its kind ever issued by an electrical supply house. It is a handsome cloth bound book, containing 555 pages, and covers by text and numerous illustrations only such material as is specially adapted to electric light work. To get some idea of the enormous issue of this catalogue which the company has compiled, it may be stated that the edition weighs 20,000 pounds, and if the catalogues were piled on top of each other they would make a column 1,000 feet high, and if placed upon the ground, end to end, they would form a line over 6,666 feet long. The book is carefully indexed, so that the articles can be found under several headings. Valuable tables and a list of electrical books are appended. The book should be in the hands of all users of electrical apparatus, and will be furnished to the trade upon application.

NEW YORK NOTES.

THE ELECTRIC ARC LIGHT COMPANY announce the removal on May 1 of their New York office to 120 Liberty street, the home of the Pioneer enclosed arc.

MR. WM. S. TURNER, M. S., the well known consulting and constructing electrical and mechanical engineer, has removed his offices from No. 1 Nassau street to the new Washington Building, 141 Broadway, N. Y. Mr. Turner has had a large and varied experience, which is shown by a long list of companies whom he has served as engineer.

WARD LEONARD ELECTRIC CO., BRONXVILLE, N. Y., enumerate sixteen reasons why their circuit breaker is the best on the market. Among these may be mentioned the absence of auxiliary knife switches, in series with the circuit breaker, and of auxiliary levers; the certainty of its opening on overload current; the impossibility to close circuit breaker when overload condition exists on the circuit; the impossibility of the switches sticking or failing to open; advantages of the iron clad solenoid magnet; the perfect switch contact, and mechanical construction; the ability to trip the circuit breaker by hand; the small space it occupies; the impossibility of an operator being hurt when the circuit breaker opens; the excellent finish throughout, and last but not least, this circuit breaker can be manufactured much cheaper than any other.

WESTERN NOTES

MR. JOSEPH M. HILL, Western manager of Bryan Marsh Company, manufacturers of the Imperial incandescent lamps, 1239-1240 Monadnock Building, Chicago, was a welcome visitor in New York last week.

THE CENTRAL ELECTRIC COMPANY claim that their stock of house goods is the most complete stock of the kind. The increased orders for goods in this department give evidence of the popularity of large stocks and favorable prices.

MR. H. J. GILLE, formerly Western representative for the Washburn & Moen Mfg. Co., with headquarters in St. Paul, has been appointed general superintendent of the St. Paul Gas Light Co. and the Edison Electric Light & Power Co., of St. Paul. These companies control all save one of the electric lighting plants, and the gas plant. They have the city lighting contract. Mr. Gille is well and favorably known throughout the entire Northwest, being for many years connected with the General Electric Co., both in St. Paul and Chicago. His numerous friends will be glad to learn of his good fortune.

ADVERTISERS' HINTS

CROCKER-WHEELER ELECTRIC CO. advertise power generators.

GEARS OF EVERY STYLE and size are manufactured by the Boston Gear Works, 27 Hartford street, Boston, Mass.

THE FARIES MFG. CO., Decatur, Ill., say to look for their exhibit at the Electrical Show at the Garden.

"PHOTOGRAPHIC ADVICE" is the title of a complete photographic manual with illustrations, descriptions of apparatus and prices. It is sent for ten cents by the Scoville & Adams Co., 60 East Eleventh street, New York.

THE MONTAUK MULTIPHASE CABLE CO. publish a list of the patents under which their cables are manufactured.

THE FUEL ECONOMIZER CO. will have their apparatus on exhibition at the Madison Square Garden.

THE GERLACH HOTEL will be found convenient in every way to the Exhibition. Mr. Baker, of the Exposition Co., is making it his headquarters.

THE VANCE ELECTRIC CO., 136 Liberty street, New York, advertise the Noxall direct current fans in three speeds. Their low price and high efficiency make them ready sellers.

DEARBORN DRUG & CHEMICAL CO., Chicago, suggest the lines on which they prescribe a boiler compound to suit the individual case.

THE ONONDAGA DYNAMO CO., 39 Cortlandt street, New York, may be found in the basement of the Garden during the show. They extend a cordial invitation to their friends to call.

THE DE LA VERGNE REFRIGERATING MACHINE CO., New York, are exhibiting a Hornsby-Akroyd oil engine.

EDWARD P. THOMPSON has removed to the Fulton Market Bank Building, New York.

THE GARVIN MACHINE CO., New York, advertise lathes of all styles and sizes, improved and up-to-date.

THE H. W. JONHS MFG. CO., William street, New York, keep commutator rings in stock for all the standard railway motors.

WILLIAMS-ABBOTT ELECTRIC CO., 154-156 Champlain street, Cleveland, Ohio, claim to be the manufacturers of the best magnetos made. They will make special prices on large lots of receivers and binding posts.

THE GENERAL ELECTRIC CO. give some of the details of the St. Anthony Falls power transmission plant described elsewhere in this issue.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. MAY 12, 1898. No. 523.

ELECTRIC TRANSPORTATION

The New Work of the Metropolitan Street Railway Company of New York.

BY E. W. STEVENSON.

THE Lenox Avenue electric road, which was equipped with the underground trolley a few years ago, has given such excellent service under the severest conditions of weather and traffic, that the Metropolitan Street Railway Company decided some time ago, after a careful investigation of all existing commercial systems of electric traction, to equip a number of its lines in the city of New York with the underground trolley. A number of these roads, the first one of which was the Fourth avenue road, have been in successful operation for a number of months and have given entire satisfaction. The mechanical features of the construction have already been very fully described in The Electrical Engineer and other journals. The latter caused considerable trouble and delay at certain points, such as Fifth street and the Bowery, where the Third avenue cable had to be crossed, and it required a great amount of ingenuity and skill on the part of the engineers to overcome these obstacles without delaying traffic. It is the purpose of this article to present some features of the electrical construction and station equipment, all of which does credit to the Metropolitan Street Railway Company and the numerous firms supplying the apparatus.

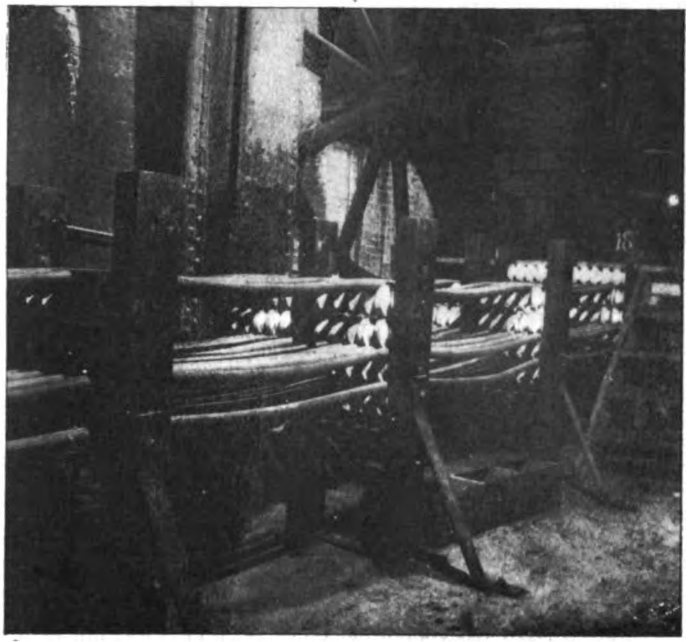


FIG. 1.—LEXINGTON AVE. CABLE TUNNEL HOLDING 14 CABLES

The actual work of laying the cables from the power houses at 25th street and 146th street was commenced in the early part of November last year, when the main feeders were drawn in by two companies—the National Conduit and Cable Co., and the John A. Roeblings Sons' Co. The first supplying a paper cable soaked in rosin oil, and the latter a combination insulation of paper on the inside and saturated jute on top, both makes, of course, being lead covered. The mains in all cases consisted of 1,000,000 c. m. cables, and for the Fourth avenue railway alone from the Brooklyn Bridge to 59th street fourteen of these cables were found necessary. These cables leave the 25th street cable house and are carried through the Lexington avenue cable tunnel, Fig. 1, to a large vault underneath the corner of 23d street and Lexington avenue, where they turn and go to 23d street and Fourth avenue. Here the cables divide, eight going up town and six down town, to various feeding points along the line where the 1,000,000 c. m. cables are tapped into two 500,000 c. m. cables. These two 500,000 c. m. cables run along the whole

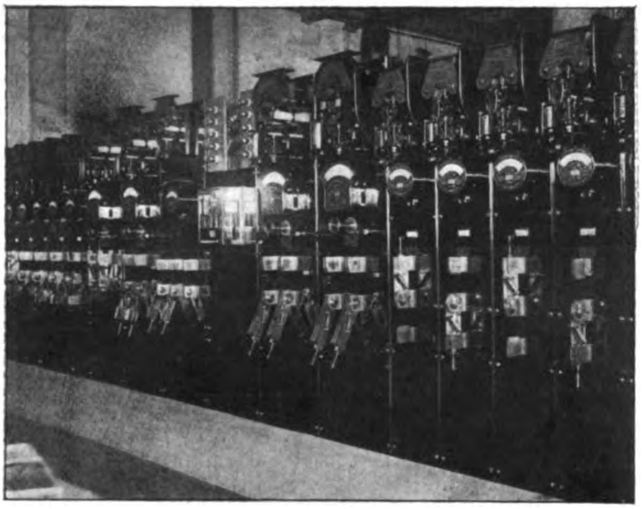


FIG. 4.—FRONT VIEW OF SWITCHBOARD, 25TH STREET POWER HOUSE.

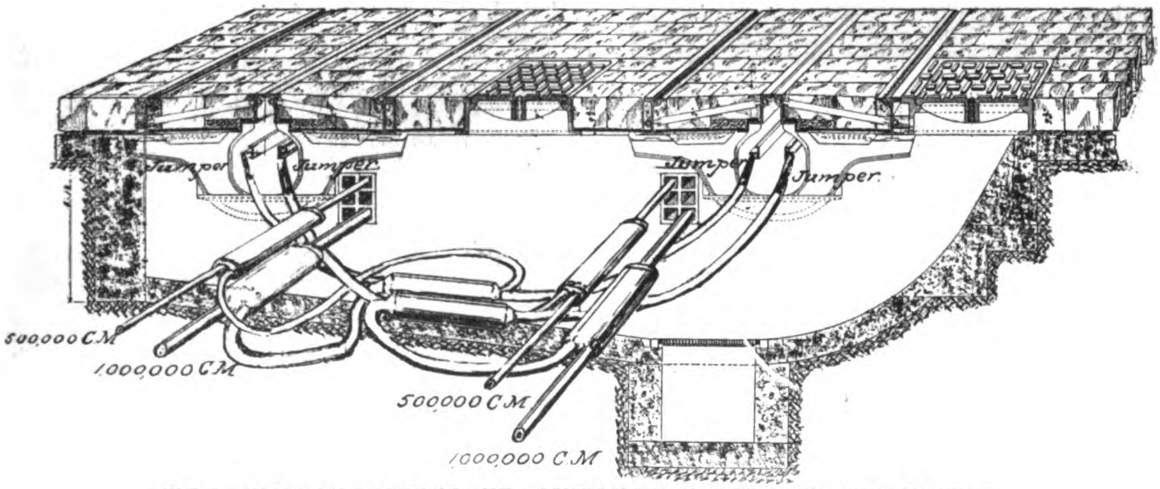


FIG. 3.—DIAGRAM SHOWING THE POSITION OF CABLES, TAPS AND JUMPERS.

length of the road and are cut into sections of various lengths. They are tapped at different points and joined to the feed rails, as shown in Fig. 2. The circuit is entirely metallic, one cable being joined to the east rail and the other to the west rail, and where these taps are made, the east rails on either track are joined by cables called jumpers, as are the west rails, shown in

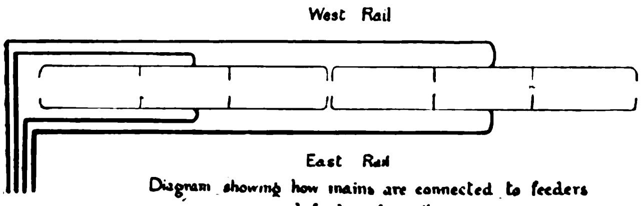


Diagram showing how mains are connected to feeders and feeders to rails

FIG. 2.

Fig. 3. It can be seen that by this system should a cable give out at any time it can be cut dead in an instant and the section joined at either end to the live rail above and below it, because where these different sections end the rails are also cut. Also by this arrangment of feeders the current is evenly distributed along the line and well able to carry any excess due to "bunching up," caused by a block.

The total length of cable used on the Fourth avenue division alone, with Amsterdam avenue branch, amounts to about 150,000 feet of 1,000,000 c. m. and 125,000 feet of 500,000 c. m. of National cable and 100,000 c. m. of Roebling cable, most of the latter feeding from 146th street station.

The stations have nothing particularly novel but are very well

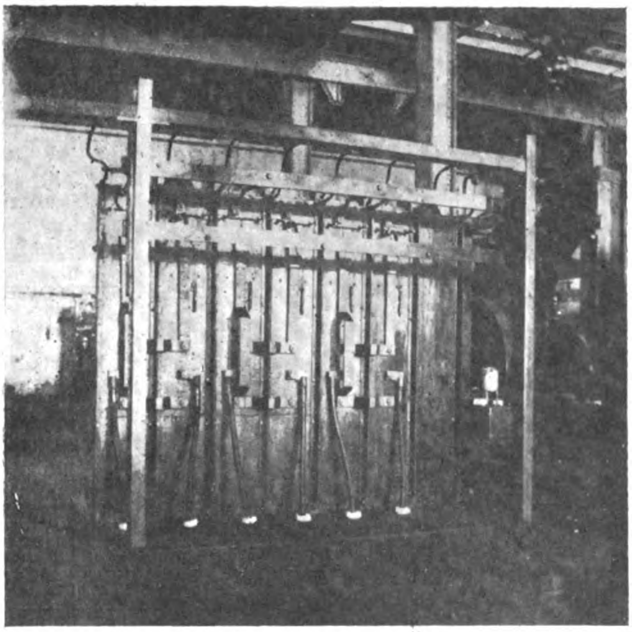
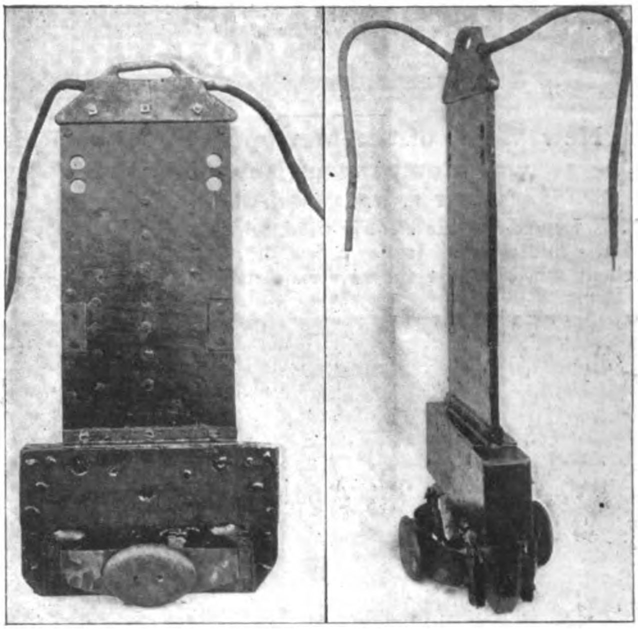


FIG. 5.—BACK VIEW OF SWITCHBOARD, 25TH STREET POWER HOUSE.

arranged, in fact one would have to travel far to see a finer looking switchboard than that at the 25th street power house; the black, highly enameled slate back sets off to fine advantage the massive switches and neat ampere meters, with an automatic cut-out at the top. Fig. 4 shows the board at the centre with a few panels on either side, and when complete will contain forty panels, each feeder having its own, and operating the Fourth avenue, Second avenue and Amsterdam avenue, and 23d street lines. In the centre of the board will be noticed two series of lamps. When either of these series is lit, it indicates a ground on the east or west rail, according to which series lights up. There is always more or less leakage in damp weather, but even when both sides are comparatively bright, showing practically a dead ground, it does not seem to interfere with the service at all. Occasionally a shoe will short circuit the rails for a few moments, or a bolt carelessly placed by a workman along the line cause a ground, but a quick application of a heavy current usually suffices to burn the trouble off. If not, a corps of trouble hunters is ready at a moment's notice to remedy the defect, so that there is very little possibility of interruption of service. In the centre of the board, underneath the ground detectors, is a recording wattmeter. The back of the board, Fig. 5, shows the large main cables attached to the jaws of the switches,



FIGS. 6 AND 7.—SIDE AND FRONT ELEVATIONS OF PLOUGH.

and also the two heavy copper bus-bars which run the entire length of the board, the lower one being six feet from the ground, while the upper is one foot above that. On either side of the wattmeter are two rheostats which regulate the generators. The engines, four in number, were made by the Pennsylvania Iron Works, and are cross compound non-condensing direct connected, capable of developing 1,500 h. p. each, while the generators are of the General Electric multipolar type, an output of 1,500 amperes at 500 volts, with a speed of 80 revolutions, normal load. The fourth one has just been put in and will be ready to run very shortly. The station has an actual capacity at full load of 8,000 amperes.

Connecting each generator through a large switch is a 2,000,000 c. m. cable to equalize the current, when two or more machines are running. The boilers are of the familiar Babcock & Wilcox type, sixteen in number. They are fed by their well known system of coal supply. There are also several Box self-stoking boilers. This battery also provides the power for the Lexington avenue cable road and the house lighting dynamos. The in-

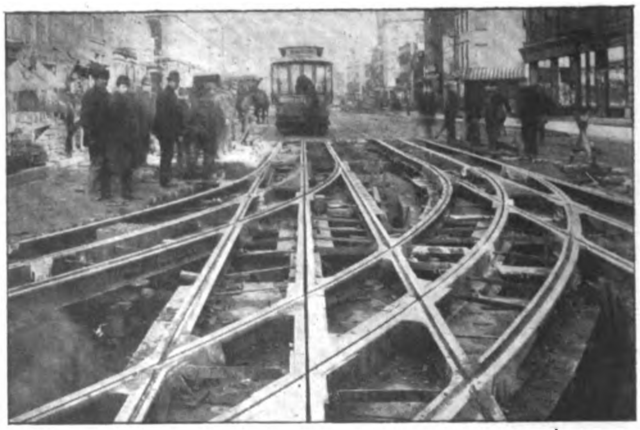


FIG. 8.—TRACK CONSTRUCTION, SHOWING METHOD OF CROSSING TRACKS OF A SIMILAR SYSTEM.

sulator used to support the feed rails is made up of a cast-iron circular cup 5½ inches in diameter, fitted with wings by which it is bolted to the slot rails. Within this cup is another of

porcelain which is held firmly in the former by cement, and which contains a 1½-inch wrought iron shank supporting the conductor rail. The latter is of iron of T-shape and weighs 7 pounds to the foot. It is in 30 feet sections bonded by copper bonds.

The plough, shown in Figs. 6 and 7, has a total width at the slot level of 9-16 of an inch and immediately above and below the slot level is 7-16 of an inch thick. The wear of the slot rails is taken up by tempered steel wearing plates 2½ inches square, and 3-16 of an inch thick. The shank of the plow is made up of three steel plates. The two outside ⅛ of an inch in width, and the middle 3-16 of an inch in width. The conductors which are wrapped with copper ribbons are carried down through the plow to the contact shoes or wipers, connection being made between them by flexible cables. The shoes are about 4 inches by ½ an

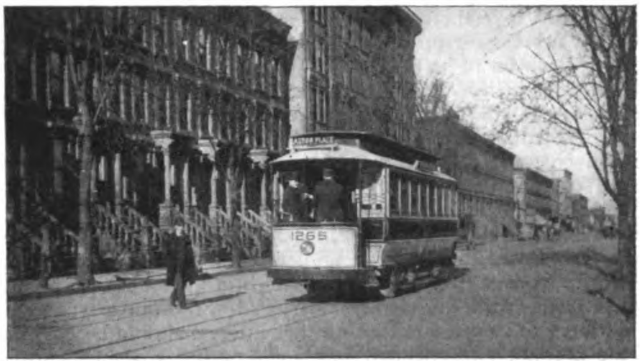


FIG. 9.—A VIEW ALONG FOURTH AVE. AFTER SYSTEM HAD BEEN INSTALLED.

inch and are of cast-iron. The tension is supplied by the side steel springs which keep the shoes extended 8 inches apart when free, and 6 inches apart when in contact with the conductors. The pressure when in contact with the latter is light, being only about 6 pounds.

Fig. 8 shows the details of construction of a crossing, without interrupting the service, and in Fig. 9 is shown how Fourth avenue appeared after the debris had been cleared away and all obstacles had been ably overcome.

Some Early Electric Railroads.

BY J. C. HENRY.

In view of the fact that there has been considerable history manufactured in regard to the first electric railroads, and to combat an official statement made by the Acting Commissioner of Patents in his last annual report that the first commercial electric road was built but ten years ago (presumably the Sprague roads, at Richmond), I send some heretofore unpub-

FIG. 1.—EAST FIFTH STREET ROAD IN KANSAS CITY, 1886.

lished views of historical interest showing my personal efforts in that direction.

The views Figs. 1 and 2 were taken from the East Fifth street road in Kansas City in the fall of 1886. Fig. 3 represents one of the trains on the San Diego and Old Town road in California, taken in the summer of 1887. Fig. 4 represents a view on the Fourth street road in San Diego, which was constructed in 1887. On the latter road, which was about five miles long, we carried as high as 150 passengers up a nine per cent. grade with a single motor. On the Kansas City road we used the double overhead structure. On the Old Town road in

FIG. 2.—EAST FIFTH STREET ROAD IN KANSAS CITY, 1886.

San Diego we used underground feeders with single overhead wires.

All of those roads were supplied from compound wound dynamos. The motor fields were wound with a multiplicity of parallel wires. The motor's resistance was varied with a switch which connected more or less of them together in parallel. The armatures ran constantly and were connected to, or from,

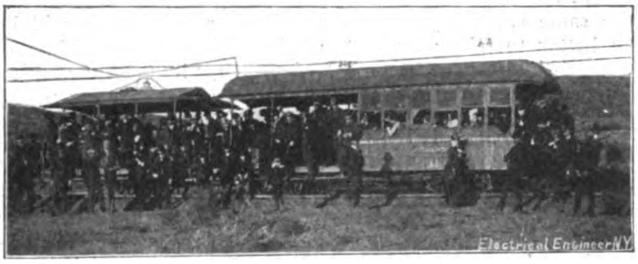


FIG. 3.—THE SAN DIEGO AND OLD TOWN ROAD IN CALIFORNIA, 1887.

the car by a combined differential gear and clutch running in oil. The diminutive trolley engaged the sides and bottom of the trolley wire. The wheels, which ran in a horizontal position, were held to the wire by strong springs. These wheels, which were three inches in diameter, were made of steel tempered "file hard." By using this form of trolley we were en-

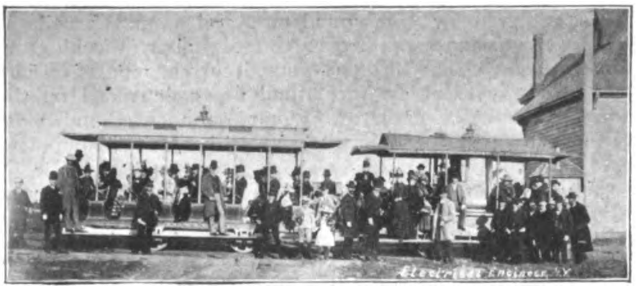


FIG. 4.—FOURTH STREET ROAD, SAN DIEGO, CONSTRUCTED IN 1887.

abled to keep up a traveling contact with the trolley wire which in some cases was 15 feet to the side of the track.

The details of the line construction and motors were worked out and tested by the writer during the years 1884 and 1885 on the Westport Road, and also on the Fort Scott and Gulf road in the suburbs of Kansas City.

MUNICIPAL AFFAIRS

Municipal Electric Lighting—A Reply to Prof. Commons.

BY HORATIO A. FOSTER.

IT has been a pleasure to read Prof. Commons' article on "Municipal Electric Lighting" in the recent issues of The Electrical Engineer, as he, unlike other writers who take the same view, has not applied a very considerable part of his argument to abuse of the motives of the other side. While I most certainly do not agree with the conclusions he teaches, if he may be said to have reached any, I have to thank him for giving a full and candid analysis of all the figures. Time and your space will not permit me to make this reply as full as I could wish, but at some later date, say, after the returns have all been made by the United States Labor Bureau, I may go into the matter more fully.

I would first like to dispel any delusion that Prof. Commons or others may have, that perhaps deep down in my soul I do not really believe in the results of my own investigations as favoring private ownership. While I do not wish to take back a single statement that I may have written and that Prof. Commons has quoted, and will even go farther and say that as an abstract theory municipal ownership seems to have strong arguments in its favor, yet I not only believe it to be wrong in practice but every personal investigation I make still further convinces me that municipal ownership is impractical, more costly any time after the first five years, and in the present condition of our municipal governments, where people are careless of official selection, and the selfishness or self-interest, born of ambition, of the same carelessly selected official is so strong, it will be much better to take advantage of that strong force of human nature, self-interest to the extent of allowing its use for gaining a profit and by proper supervision compel the supply for public uses at reasonable rates and profits. I want to go further and say that outside the very large number of plants that have been installed in villages, where a private plant could not exist and where therefore cost cuts no figure, the establishment of municipally owned plants in many of the larger places has been very largely due to the arbitrary actions and greed of the management of the local plants, and as the most exaggerated instance of this I will cite that latest and most complete plant at Detroit, where the action of local companies is history of recent date.

Now as to accuracy of reports: I think it was mentioned in my report, so largely quoted from by Prof. Commons, that the figures were given for what they were worth only, and when "guesses" were made they were guided largely by experience and not theory. I agree with him that the quality of such work depends largely on the painstaking care of the investigator, but it is impossible to go behind the returns in such cases, especially so where the investigator is representing the "off" side of "Municipal Ownership." Personally I have little faith in statistics gathered by correspondence, and Hon. Carroll D. Wright, Commissioner of Department of Labor, Washington, personally told me that when he wanted correct reports on any subject he always sent an agent, and never depended on the accuracy of statistics gathered by correspondence, and most likely to be made up by some one not having proper equipment or taste for such work.

In spite of our opinions, however, the results of two different investigators occasionally agree in a quite astonishing manner as exhibited by Table III, of Prof. Commons' article.[1]

If I am right in assuming that Prof. Commons agrees that his two investigators are probably correct in all items of operating expenses it leaves only fixed charges for discussion, and there being some question as to the proper place for charging insurance and relinquished taxes, both can be dropped as there seems to be no disagreement about them, and I shall therefore have nothing to say regarding those items. The two main items of dispute then remaining are rates of interest and of depreciation.

It seems impossible to reach any sort of agreement as to interest charges on any plant, public or private, and as regarding the rate "guessed" at by the writer as 6 per cent., I am perfectly frank to say that the rate is high according to our present knowledge, but at the time my report was made up, finances in the West were in such a state as to make borrowing difficult at any lower rate, and it will be noticed that with few exceptions the municipalities for which such "guesses" were made were located in that section of the country.

Prof. Commons disagrees both with the method of Prof. Parsons, in charging interest on the outstanding debt, and with my own of charging interest on the entire cost. I will not take space to analyze the method used by Prof. Parsons but will simply state the reasons for doing as I have in charging interest on the full cost. I have taken as a basis, that municipal financing could hardly be superior to the financing by those in commercial life whose standing and opinions were without question, and, as early in my investigations into cost of steam power this item came up for discussion and was settled for me for all time by those in position to be the best of judges on such points, I have felt perfectly justified in charging interest on full cost as shown. The theory is simply this, that if one invests money in a dwelling house to be used by himself, and pays for it cash down, the real cost to such a person for annual charge on the house, in lieu of rent paid to another owner, will be the interest he relinquishes on the full amount paid for the house.

Now I think there is no municipality so happy as to be entirely free from interest-bearing debt, and if money be taken arbitrarily from taxpayers to build a lighting plant while interest is still being paid on money borrowed for other purposes it would seem to be good reasoning that interest should be charged on the amount appropriated when computing costs of output. The argument that interest charge in a municipality is simply changing money from one pocket to another might apply if each taxpayer held a proportional amount of the bonds on which interest is paid, but such is never the case. It might even have some justification if it were a fact that some bank or individual or association of individuals in the town held the bonds; but when the fact is that it is almost invariably the case that such bonds are bought by outsiders who take the interest away, it would seem far fetched to assume that the taxpayers are saving interest when a new appropriation has to be made for each and every addition to plant.

While it certainly is somewhat difficult to exactly compare the financing of a municipality with that of a private corporation, I repeat that one has to be in the greatest measure guided by those financial methods that have proved the most successful in commercial practice, and I feel perfectly justified in charging full interest on the full cost of plant to the date under consideration.

Taking up depreciation, I am sure that Prof. Commons would confer a distinct favor on the owners of private plants if he could inform them how to make their existing plant last long enough to justify the low charges for depreciation quoted by him as being ample; and if some law of nature could be found that would compel theorists to take a post-graduate course in experience with the subject under discussion, à la Prof. Walter Wyckoff, the results would undoubtedly be to raise the estimates on the costs of carrying out such work.

Prof. Commons very properly divides depreciation into three kinds. viz., "depreciation by use," commonly known as repairs and as such charged into operating expense; "depreciation by competitive improvements"; and "depreciation by replacement."

The first of the three needs no discussion as it is fully agreed that it is a true operating expense.

It is on the second item that Prof. Commons and I do not agree. His discussion of the causes for change of machinery, the saving thereby, etc., is full and complete and I find no cause for disagreement with his conclusions excepting as follows: He assumes that private corporations have been able to stand the strain of constant change of plant, by reason of their ability to charge the same prices as "a decade ago," which he can easily learn is not the case if he will consult some one of the latest lists of municipal prices for lighting. He also says: "Certain it is that the charges by private companies for either public or private lighting have not fallen in proportion to the great improvements in production, etc.," in which he is right; but the very good reason exists for it that under the older condition few of the private companies made a profit of any kind, and the reduced expense accruing from change of plant simply permitted them to in a few cases reach that very desirable condition.

[1]Elec. Engr., p. 265, March 10, 1898.

There seems to have gotten abroad the idea that all electric lighting companies have always made big profits and at every increase of stock or bonds the public in general has cried, "Water!", when in fact it was new life blood infused to permit existence, and if one will only carefully study the annual reports of the Gas and Electric Light Commission of Massachusetts and notice the difference in profits between the gas companies and those electric lighting companies making any profits at all, and then take into consideration that those companies are probably as conservatively managed as any of like business in the country, it pretty soon ought to become evident that the electric business as a business is mighty likely to prove itself short on dividends.

But to return to the subject; he says: "This kind of depreciation is not to be computed as a fixed charge, since it already shows itself in operating expenses by high cost of fuel, labor, repairs, etc." Now this certainly is queer reasoning, for extra money is spent for the new kind of machinery and such expenditure has just as certainly not added anything to the gross earning capacity of the plant, and cannot therefore be added to plant account, and if not, where should the charge be placed? The fact is, that not only has the cost for fuel, labor and repairs been increased by use of the poorer class of plant first installed but the depreciation has been equal to the entire first cost of plant displaced, and the item really merges into the third kind of depreciation or, depreciation by replacements which in ordinary business would mean replacing old machinery by new as fast as the old could not be kept up in efficiency by ordinary repairs. It is the two kinds of depreciation combined that I have always had in mind when charging 7½ per cent. on entire cost of plant.

Prof. Commons tries to prove by example that 7½ per cent. is altogether too high and I have been criticised by others for keeping the rate up, but I am sure that those who are familiar with American practice in the installation of electrical apparatus will bear me out in the rate if they charge off any depreciation at all. Prof. Commons makes the usual error of comparing practice in foreign cities with rates as estimated in the United States. This fallacy should be entirely disposed of by comparing the style of construction in the cities he mentions with that of the usual American city. That at Detroit and some of the later Chicago plants are the only ones that would for a moment bear comparison with those built in foreign cities and I am sure if Prof. Commons had examined personally both financially and technically the something over two hundred and fifty plants that it has been my fortune to do, he would bear me out in the correctness of the rate I have assumed. I have personally visited a number of municipal plants, and while I can freely admit that most of them have been well cared for, the machinery is of the same type and liable to the same troubles as is that owned by private companies.

In addition to the troubles liable in the ordinary running of a plant, that owned by a muncipality has other causes for disaster. Within the past few weeks I have had occasion to discuss such matters with two ex-superintendents of municipal plants; one said that no lighting committee did he ever work under but demanded that for that particular year he would have to run the plant cheaper than for any previous year, and to insure that being the case they would allow no repairs of any nature, the result being that before five years were ended the plant was entirely rebuilt.

The other man was superintendent of one of the Massachusetts municipal plants and was forced out of his position because he would not employ all the help that was tendered him, and which has been employed since the change of management.

Dunkirk is changing that much talked of plant all around, occasion being made for it by reason of the addition of an incandescent dynamo for commercial use. A large new engine capable of driving the whole plant is being erected, the dynamos rearranged, an addition being made to the building, and if good judgment be used throughout, the two or three small and very inefficient engines in use up to now will be abandoned entirely.

Prof. Commons calls attention to the small rates of depreciation reported for Massachusetts. These rates are small as yet but will be gradually increased as the Commissioners become able to induce such increase, as it has been only by the hardest kind of labor that the present rate has been achieved, owing to the very small amount of profit shown.

It is to be hoped that stations erected in the future will embody those features which should bring the rates of depreciation down to those shown by Prof. Commons' article, yet Americans are invariably in a hurry for dividends and demand a quickly built plant, and as such plant can never be low in depreciation I should dislike to prophesy that the necessary improvement would soon be forthcoming.

In conclusion I may say, that until considerably better arguments are brought forward I shall remain of the opinion that interest rates will be nearer 5 per cent. than four in most of the Western States and that 7½ per cent. depreciation is none too great to charge on plants as now constructed for municipal or private ownership.

MISCELLANEOUS

Armature Reactions in a Continuous Current Dynamo.

BY C. A. BESSEY.

IN the Junior laboratory course in Electrical Engineering at the University of Nebraska, the following study of armature reaction, made jointly by myself, Mr. R. S. Mueller, and Mr.

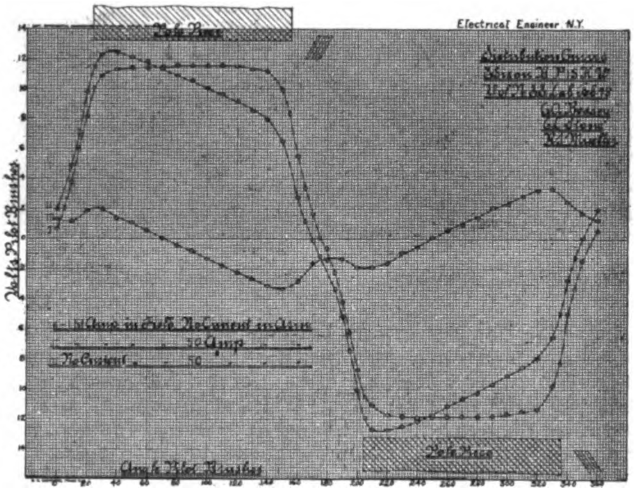


FIG. 1.

C. E. Stone, gave results of such clearness that they may be of interest to others. It being desired to show exactly the extent of the influence of the armature upon the field in both simple shunt and compound machines, it was decided to take three sets

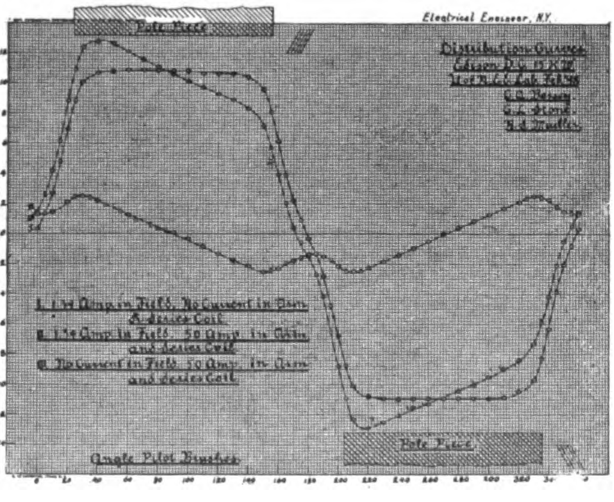


FIG. 2.

of curves in each case as follows: First, the induction distribution with field excited and no current in armature; second, with field excited and 50 amperes in armature; and third, the induction

distribution with 50 amperes sent through armature from an external source and field magnetism previously reduced to zero.

The machine experimented upon was a 15 k. w., 125 volt, Edison bi-polar dynamo run at 1,600 r. p. m. The induction distribution was obtained by measuring with a Weston voltmeter the e. m. f. between two steel watch spring pilot brushes bearing on commutator and shifted into different angular positions. Wirt collector brushes were used and after being given proper lead for non-sparking at 50 amperes, were fixed in this position through the experiments. In the experiments, both as a simple shunt and compound machine, the e. m. f. between collector brushes when loaded, was 110 volts.

Referring to Fig. 1 for simple shunt machine, curve I shows the induction distribution with 1.51 amperes in field and no current in armature. It is seen that the induction distribution is nearly uniform over the pole face. Curve II shows induction distribution with same current in field and 50 amperes in armature. Here the weakening of leading and strengthening of trailing pole tip is apparent. Curve III shows induction distribution with 50 amperes through armature in same direction and field magnetism zero.

It is of interest to note that curve II is almost exactly the algebraic sum of curves I and III, as it of course should be. It is also noticed that curve III does not cross the horizontal axis under collector brushes, as erroneously indicated by Jackson and others. Indeed, were it not for the increased reluctance in the path of the armature lines between opposite pole tips, curve III would be a maximum at the point of commutation. The effect of lead is seen to cause curve III to become zero about 20 degrees from the centre of the pole instead of being zero in the middle of the pole face, as would be the case were lead absent. Compounding coils changes this as will be seen later.

In Fig. 2, curve I shows distribution with current of 1.34 amperes in field and no current in armature, and is of course similar to curve I, Fig. 1, but its ordinates are not so great. In this case, however, because of the series magnetizing turns, the shunt current was reduced to 1.34 amperes to make the main brush voltage 110 as before. Curve II, Fig. 2, is practically the same as curve II, Fig. 1, as it should be under the conditions. Curve III shows the induction distribution with 50 amperes in field and 50 in series coil. In this case the effect of the series turns is to make the armature induction distribution practically uniform about the centre of the pole face.

Electricity In the Submarine Boat "Holland."

BY R. McA. LLOYD.

AT the present time the only practicable power for the propulsion of submarine boats is electricity, and if the boats are to have a considerable radius of action, the power must be carried in storage batteries.

The "Holland" and its principal features are now quite familiar to the public, and a complete description of her design and equipment is here unnecessary, but a few facts about her electrical apparatus may be of interest, particularly as it is the first of the kind and will doubtless be followed largely in future practice.

FIG. 1.—THE SUBMARINE BOAT "HOLLAND."

There will be various classes of submarine boats, including, for example, those that carry steam engines for surface running as well as for charging batteries; boats that have gasoline engines for the same purposes; boats that have in them no prime motors, but get their current for charging batteries from tenders or from plants on shore; besides other classes that will suggest themselves.

The "Holland" has a small gasoline engine and a large storage battery. The boat fully equipped weighs out of water about 75 tons. Of this 22½ tons is the weight of the storage battery. This consists of sixty cells built by the Electric Storage Battery Company especially for this purpose. They are installed in a lead lined compartment, and built substantially together, so that no ordinary amount of motion can injure them. The containing cells are light steel structures covered inside and out with sheet lead and lined inside with thin hard rubber. The cells are separated from each other by hard rubber and wood, and the plates are well protected by hard rubber separators. The plates are attached to and suspended from lead covered copper bars, which run from cell to cell, so that one positive and one negative are connected to each bar. These bars are further covered with hard rubber sleeves at the points where they rest

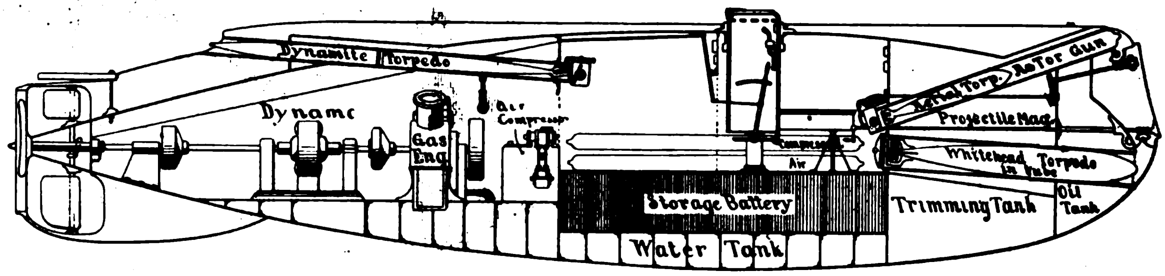


FIG. 2.—SECTION OF SUBMARINE BOAT "HOLLAND."

on the sides of the containing cells. This method of connecting the cells together permits of a great economy in room, besides great current capacity in the circuit.

The boat is well protected from damage by electrolysis, and the battery solution cannot spill unless the boat rolls or pitches 25 degrees, from a horizontal plane. The compartment is, however, drained and water which might accidentally get into it would not remain. It is also ventilated during the periods of charging by a suction blower, which draws the fumes from the battery compartment and drives them into the open air.

The battery may be discharged at 350 amperes for four hours, or at 700 amperes for one hour. When the battery is discharging at 350 amperes, the boat has a speed of 8 knots per hour, which is fast enough for submarine operations. When running on the surface the gasoline engine provides power for running at a 6 knot speed, and the boat carries enough fuel to drive her 1,000 miles. The engine is a 50 h. p. Otto marine gas engine and has proved very satisfactory.

The propeller shaft, dynamo and gas engine are so connected together by gears and clutches that the propeller may be driven either by the engine or electric motor, or by both, or he engine may simply drive the dynamo for charging the batteries. Of course, the dynamo and motor are the same machine in both cases. This machine was built by the Electro-Dynamic Company, of Philadelphia, especially for this work and is capable of developing 50 h. p. at 8 revolutions, or 150 h. p. at 1,200 revolutions. It weighs about 4,000 pounds and has a double wound armature with two commutators. The variations in speed are obtained first by combining the two armature windings in series, and including in the circuit a considerable resistance; second by the windings in series, and third by the windings in parallel. There is a controller of large capacity with a reversing attachment. The machine is shunt wound and when running as a generator may be varied from 120 to 160 volts by a large field rheostat.

There is a 10 h. p. motor for driving the air compressor and several small motors for yentilating and pumping. There is also a substantial switchboard and a complete electric lighting outfit.

A contemporary electrical journal editorially regrets that storage batteries are too heavy for submarine boats and suggests primary batteries, referring also to their advantage in the absence of fumes and gases and in freedom from spilling. These advantages are not easily discovered in the primary batteries known to electrical engineering, and are not as necessary as might be supposed from reading the editorial referred to. There is no difficulty whatever in carrying sufficient storage battery capacity for a whole day's operations, and if the boat is provided as is the "Holland" with a gasoline engine, the batteries may be recharged while the boat in on active duty. The "Holland" is in no way inconvenienced by gasing, as the battery compartment is thoroughly ventilated while charging is in progress and the boat on the surface. There is no spilling of acid because the cells are designed to prevent it, but if it should occur by any accident the compartment would be immediately drained into a lead receptacle from which the liquid would be pumped into the sea.

The interior of the "Holland" seems a little crowded, but that is to be expected in warships of all kinds. The entire battery is under the floor of the torpedo room, and can be examined by taking up sections of this floor.

For surface running the gas engine is used ordinarily, and the boat with its tiny conning tower is a dangerous antagonist even in this position, and is good for a thousand miles, but it is only a moment's work to shut down the gas engine and with electric power dive to a safe depth and run forty or fifty miles. With fifteen feet of water above her conning tower, there is little daylight available, but there is plenty of electric light, and plenty of air stored in the compressed air tanks. She carries a Whitehead torpedo always ready for a hostile ship, and dynamite shells for throwing into the enemy's forts. She has within the past few weeks demonstrated her ability to do all of these things, and has performed in New York harbor before many witnesses. She has not only kept her bearings under water for a mile but has run a number of consecutive miles, coming to the surface for a moment's observation at the end of each mile. She has bumped on many an oyster bed without injury to herself and has floated serenely in a heavy sea without discomfort to her crew. We are indebted to the "Scientific American" for the sectional view.

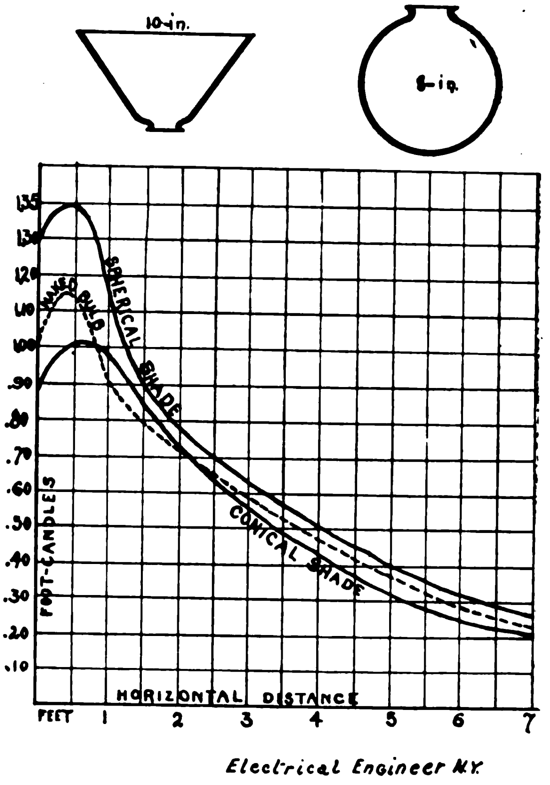
ELECTRIC LIGHTING

Conical and Spherical Shades.

BY I. C. THOMPSON.

SINCE the note published in The Electrical Engineer of March 17, further tests have been made for the purpose of comparing plain conical with spherical shades used with 16 c. p. incandescent bulbs under similar conditions to those in the previous experiments, and in the same room. The results obtained at different times are plotted in the accompanying curves. The shades are drawn to scale except as to thickness of glass, the 8-inch spherical one being of clear glass ground on the inside, while the conical shade was tested in the position shown while holding a 16 c. p. lamp; this shade was of opal glass of average thickness.

Upon comparing these curves it will at once be seen that the horizontal illumination curves follow about the same law beyond 2 feet measured horizontally from the light source. The spherical shade gives higher results, probably by reason of inside top reflection, the bulb being located in the upper part of the shade, and less light going into the ceiling than one would suppose. The naked bulb lies very little below it, while the opal shade, by reason of its higher percentage of absorption, naturally gives less illumination. This would indicate that unless the ceiling is



COMPARISON OF PLAIN, CONICAL AND SPHERICAL SHADES.

a very good reflector of light, very little of the luminous effect of the light refleeted upward from the inverted shade would reach the floor.

The effect of the reflection powers of various colors and characters of surfaces is not sufficiently appreciated. Where the lighting is of necessity economical, it makes a great difference whether the ceiling walls and furniture reflect 50 per cent. or whether they reflect 10 per cent. of the light they receive. Offices, workshops, school rooms, lecture halls, etc., therefore, should be finished in the lighter and warmer colors in order that a minimum of light may be necessary for their proper illumination. The following list of colors with the respective reflective properties will make this point clear:

PERCENTAGE OF LIGHT REFLECTED FROM VARIOUS SURFACES.

	Per cent.
Black velvet (Sumptner)	0.4
Black cloth	1.2
Deep chocolate (Sumptner)	4.0
Black paper (Rood and Tufts)	4.5
Dark blue (Tufts)	6.5
Dark green (Tufts)	10.1
Dark brown (Sumptner)	13.0
Bright red (Tufts)	16.2
Dirty yellow (Sumptner)	20.0
Dark brown (Tufts)	23.2
White sandstone (O'Conner)	24.0
Blue paper (Sumptner)	25.0
Yellow cardboard (Sumptner)	30.0
Straw yellow (Tufts)	34.4
Yellow paper or paint (Sumptner)	40.0
Green paper (Tufts)	46.5
Yellow paper (Tufts)	50.0
Gray paper (Tufts)	50.0
Light colored wood (Sumptner)	50.0
Bright yellow paper (Tufts)	50.3
Light orange paper (Tufts)	54.8
White paper (Atkinson)	70.0
Freshly fallen snow (Atkinson)	78.0
White-washed ceiling (Harrison)	80.0
Dead white (Hallock)	80.0
White blotting paper (Sumptner)	82.0
Mirror (Sautter)	83.0
White cardboard (Tufts)	92.3

The above figures show how important it is to select the proper tint or paper for a wall or ceiling. Not less important is the selection of shades. The diffusion of light, having for its object simply ease upon eyesight, considers but the area of the light source and its color. Thus with shades of the same size and color, that one should be selected which absorbs the least light during transmission. Data upon this subject is quite meagre. There does not seem to be any reason why the makers of these shades should not give the percentage absorption along with the description contained in their catalogues. This practice would no doubt lead to considerable improvement in diffusion globes and shades. In order to better illustrate the losses arising from the use of various shades, according to the several authorities quoted, the following list has been compiled:

PERCENTAGE ABSORPTION OF LIGHT BY VARIOUS SHADES.

	Per cent.
Clear glass (Stort)	6.0
Clear glass (O'Conner)	10.6
Clear glass (O'Conner)	12.0
Clear glass, engraved (O'Conner)	24.0
Clear glass, engraved, average (O'Conner)	35.0
Clear glass, engraved all over (O'Conner)	40.0
Flash coated globes (Stort)	11.0
Frosted glass, tulip (Lewes)	11.2
Ground glass (Lewes)	12.4
Frosted glass, pink (Lewes)	23.2
Ground glass (O'Conner)	29.5
Alabaster glass (Palaz)	15.0
Opal glass (Palaz)	20.0
Opal glass, pink (Lewes)	34.1
Opal glass, milky (Palaz)	30 to 60.0
Opal glass, smooth (O'Conner)	52.8
Opal glass, ground (O'Conner)	55.8
Opal glass, white (O'Conner)	60.0
Opal glass, colored (O'Conner)	64.0

It must be also remembered that absorption varies directly with the opacity of a shade, and therefore with its thickness, the degree of milkiness, or the extent to which it is ground or tinted.

Of the two shades used in these tests the spherical is decidedly the more ornamental and gives a light having a rich alabaster effect. Many so-called opal globes have a slightly yellow tint which is pleasant to the eyes and has a warm effect, but they absorb considerably more light. Engraved or ornamented clear glass which permits any rays to penetrate the eye direct from the incandescent filament, is but a half-way measure and should be considered as such. In general it is far better to have a naked light enclosed by a translucent shade in a light tinted room, both having a low percentage of absorption, than it is to have the same light in a clear glass shade toned down by dark walls and furniture.

It is good luminous effect we are after, and if we can secure at the same time ornamental effects, so much the better. Holophane globes afford an economical and brilliant light, but it must be observed that they simply cut one large light source into many small ones, each of which is still quite bright. The effect is brilliant, not soft. Nevertheless, where brilliancy is desired for display purposes, they do very well, but are not so well adapted for room lighting.

Mr. R. Richards, an English authority, has given some figures which may be of interest as regards the quantity of light in foot candles which is necessary for various purposes. Among them are: House lighting: general, corridors, halls, etc., 0.4; living rooms, 0.5; bedrooms, library, study, 0.25; table lighting, 2; this does not include reading, sewing, etc. Workshops: general illumination, 0.2; benches, 3.3; optical or fine work, 5. Public halls: general lighting and auditoriums of theatres, 0.33. Churches: general lighting, 0.25; pews and pulpit, 2. to 3.5. Street lighting, 0.10 to 0.12. These figures vary somewhat from those of other authorities, for here as elsewhere, the doctors seem to disagree.

Use of the Enclosed Arc Lamp in Textile Mills.

TEXTILE manufacturers throughout the country for many years have been carrying on experiments in their endeavor to secure an artificial light which would enable their operatives to work with the same facility as in actual daylight, and to produce material in the dark winter days not less perfect than that made in the full light of summer. Gas has long been discarded by the progressive manufacturer as an inadequate and unsatisfactory illuminant, and even the introduction of the Welsbach has had little or no effect in bringing gas back into favor. The necessity of a light which will not falsify colors to the eye and not injuriously affect it, precludes the use of even the most recent types of improved gas burners.

The series arc lamp of the type commonly used to illuminate the city streets has been, and even is now, in use in many mills. This lamp with a clear globe, as generally used, has been found too glaring and penetrating, and while giving a large quantity of light, has proved inconvenient and unsuitable on account of the uneven diffusion of the light, the creation of heavy shadows and the necessity of changing the carbons daily. The inverted arc lamp with the inverted umbrella-shaped reflector has also been tried, and while the results have been fair, the combination of the large reflector and the lamp is cumbersome and objectionable in appearance, while the necessity of keeping walls and ceilings constantly white is expensive.

The advent of the enclosed arc lamp has, for the first time, given the textile manufacturer a means of illumination which overcomes almost all the different objections and is peculiarly adapted for all classes of mill work. In this lamp the two carbons burn in a small glass receptacle held between the sides of the frame and completely surrounded by the outer globe. The outside air is excluded from the arc by the interior glass receptacle, and thus the carbons burn from 100 to 150 hours without renewal. The light is extremely brilliant and is softened and thoroughly diffused by using globes of opalescent glass of varying degrees of translucency.

Arc lamps of this type, known as enclosed arc lamps, were first developed for direct current and have come largely into use. They have recently been perfected by the General Electric Company for use on alternating current circuits also, and may, therefore, be used either in mills already furnished with their own direct current or alternating current dynamos or taking electricity from systems used to light the city streets.

Enclosed arc lamps have already proved satisfactory illuminants in mill rooms, where spooling, skeining, sorting and other delicate work is carried on, as well as in the stock-rooms, dye-houses, etc. The quality and intensity of the light for different requirements and classes of work being susceptible of regulation and variation by the use of different translucent globes, an almost ideal light is obtainable, as nearly like that of day as is possible with artificial light. The light from the arc, instead of being concentrated and glaring, is perfectly diffused, eliminating all heavy shadows and allowing of results which could not be obtained by any other artificial means of illumination.

The advantages which the enclosed arc lamp offers will readily be appreciated by mill owners and mill operators. The carbons burn for a long time, and a small number only is required, and the labor of trimming is very small. It is not necessary, therefore, to have a special man occupied solely in trimming arc lamps during the day.

The direct current enclosed arc lamp burns for about 150 hours with one trimming, that for alternating current about 100 hours. In certain mills where these lamps have been installed

the light is seldom used in summer, and in winter only a few hours daily; under these conditions re-carboning is necessary only about twice a year, while the cost of carbons is about five cents. Of course, in other mills where artificial light is necessary for longer periods during dark days or into the night, re-carboning is necessarily more frequent, but compared with open arc lamps, the cost of attendance is very small, while that for carbons shows a marked economy. With open arc lamps a large amount of carbon dust collects in the globe; thus when the globe is cleaned or dusted out by the trimmer the dust usually settles over everything that may be in the vicinity. With the enclosed arc lamp there is little or no dust, the combustion being almost perfect, and any that may be is collected in the small receptacle and held, as it were, in a bottle to be emptied where it cannot settle on any material or into machinery.

LETTERS TO THE EDITOR

Patents on Self-Oiling Engines.

On page 487 of your May 5 issue under Legal Notes there is an article relating to a decision made against us in favor of the Fisher Foundry and Machine Company. In reference to the matter we beg to state that such a decision was made in favor of the Fisher Company by Acting Examiner Jones. We immediately appealed the case and such an appeal was granted, and a hearing is set for June 17.

Since the decision was made by Acting Examiner Jones it has been ascertained that he had some doubts about glands and that he consulted others in making his decision. This decision, of course, as you well know is therefore void, and on these facts an appeal has been granted. Further we beg to state that the Imperial engine is covered by many patents, and there is not any question at all but at the next hearing the decision will be reversed and decided in our favor.

WESTON ENGINE COMPANY,
H. L. Hollister, Mgr. Sales Dept.

Painted Post, N. Y.

LITERATURE

TRANSFORMER DESIGN. By George Adams. New York, 1897. Spon & Chamberlain. 70 pp. 4¾ x 7 inches. Cloth. Price, $1.50.

This book forms a valuable addition to the literature of the transformer largely because it presents the problem of transformer design in such concrete form that it should be an easy matter for the reader to pass from the theory to constructive practice. On the other hand, some of the statements made may prove rather misleading, and the book can hardly be said to cover the subject fully.

On page 2, for instance, regulation is omitted from the list of objects to be kept in view when designing a transformer, whereas it is generally considered one of the most essential features of good modern apparatus. Likewise we find no mention of transformers for use with polyphase currents, concerning which the need for information is greater than of the simple transformer, and which might properly be expected to find a place under the broad title of "Transformer Design." Similarly, the subjects of mechanical construction, oil insulation, cooling arrangements and so forth have been scarcely touched upon, although the author may not have considered these to fall within the scope of the work. They would, nevertheless, prove welcome additions to a second edition.

A statement calling for some criticism is found on page 12, in which the author says that the drop in secondary voltage at full load in excess of that accounted for by the resistance of the copper circuits is due to magnetic leakage. This was the opinion formerly held concerning this drop in secondary potential and it is found in most of the older textbooks; but more recent experiments have shown this view to be untenable. Actual measurements of magnetic leakage in transformers have demonstrated conclusively that of the drop in excess of the C R loss, only a very small proportion is due to magnetic leakage. What actually occurs may be readily understood by considering the physical actions and reactions in the transformer, points upon which this little book touches only lightly.

The primary of a transformer has a given resistance upon which a comparatively high alternating voltage is impressed. Obviously an enormous current would flow through the primary winding, were not the impressed electromotive force opposed by a counter electromotive force nearly as great, generated by the alternating flux in the iron core. The difference between the primary and counter electromotive forces is a small quantity, hence the current flowing through the primary is also low and proportional to it. Precisely similar phenomena, as already pointed out, take place in the armature of a direct current shunt motor revolving free.

It will be seen that since the primary e. m. f., as well as the phase difference between primary and counter e. m. f., remains practically constant at all times, the only way in which more current can pass through the primary coil is by a decrease in the counter e. m. f. But the counter e. m. f., like the secondary e. m. f., depends only on the flux in the core, which must then decrease with load in order to effect the lowering of counter electromotive force which permits an increased current to flow through the primary. Experiments prove that this diminution of flux throughout the entire core, results from the phases of the primary and secondary currents coming more into step which, since one has a positive and the other a negative value, decreases the resultant magnetizing effect on, and therefore flux in, the core. Failure to understand this principle may lead the designer to adopt costly devices to change the shape and position of the winding as well as the shape of the core, in the hope of overcoming an apparent magnetic leakage which, in reality, does not exist.

In other parts of this book, some excellent formulas for design are given, illustrated by numerous curves and tables which show just where to begin, in preparing a new design, and how to proceed. Of course, the figures of manufacturing expense as well as the determining element in the design are meant to serve only as examples and must be varied either to suit American practice or whatever condition is determined upon as the most important in each case. And here it should be said that our practice has been somewhat overlooked in this book, at least in so far as there is little or no mention of the results attained in recent years by several American companies in increasing the all-day efficiency and improving the regulation. Nor has the effect of age on the iron of the core been taken up, although the larger manufacturers on this side of the Atlantic have given the matter much attention with a view to overcoming the increased iron loss that results with time.

A novel form of core plate has been suggested by the author on page 28, which seems to have the advantage of slipping easily over the formed coils without introducing any additional air gap in the magnetic circuit.

On the whole this book will repay careful study, and cannot fail to prove useful to a large number of students and engineers.

JOSEPH BIJUR.

Origanization of the Bolton Falls Electric Co.

The Bolton Falls Electric Company has recently been organized to develop the Bolton Falls, 4½ miles north of Waterbury, on the Winooski River. The river at this place falls 46 feet and the power is estimated at 3,000 h. p. The company is now asking for estimates on water wheels, penstocks, construction of dam and electrical equipment. The dam is 46 feet high by 120 feet long. Plans and all information can be obtained from G. H. Almon, manager, Montpelier, Vt. The directors of the company are C. L. McMahon, Stowe, Vt.; G. H. Almon, Montpelier, Vt.; G. E. Moody, Waterbury, Vt.; C. C. Warren, Waterbury, Vt.; G. W. Randall, Waterbury, Vt. The officers are G. E. Moody, president; C. C. Warren, vice-president; C. L. McMahon, treasurer; G. H. Almon, manager; C. D. Robinson, clerk. The power is to be used by the Mt. Mansfield Electric Railway, Vermont State Asylum for the Insane; Waterbury, Vt.; Waterbury Center, Vt.; Stowe, Vt.; Jonesville, Vt.; Richmond, Vt.

THE

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At the Exhibition.

IF any of our readers have the opportunity to visit the Electrical Exhibition at Madison Square Garden and have not yet done so, we urge them strongly to go there as soon as they can. It is at once a beautiful and instructive spectacle, and those who know say that New York has never seen before so fine a display of machinery and scientific apparatus. There are many distinctive features of a purely popular or sensational interest, but the management has kept steadily in view two points, the sale of exhibited apparatus to those who now require it and the education of the greater public so that it in turn will join bodily the ranks of those to whom electricity has become an absolute necessity in every sphere and department of business and social life. It is not the least significant part of the whole matter that this altogether satisfactory exhibition should have been assembled at a time when after thirty years of peace the nation is straining every nerve to end quickly a righteous war. But the public realizes that electricity is perhaps our best weapon and wants to know what more may be expected from it.

Telegraphy in Warfare.

PROBABLY there was never a more striking demonstration of the value of electricity in warfare than the painful suspense we have all endured in waiting for the glorious news from Commodore Dewey. He cut the cable, but what a grand thing it would have been if he had had with him some good cable men who could have taken hold of the cut end and kept one of his ships in touch with the outer world. As a special dispatch from Washington well remarks: "The battle of Manila offers an illustration of the wisdom of having experts in telegraphy and electrical engineering attached to every army or fleet. It ought not to have been necessary to keep the world so long in ignorance of what Commodore Dewey had actually accomplished. If the electrical end of his establishment had been cared for as scrupulously as its strictly fighting end, he could have made his victory even more complete in its moral effect by showing the Spaniards the hopelessness of a war against so ingenious a people as ours." There is one brilliant electrical engineer with the Dewey fleet, Lieut. B. A. Fiske, but he is helpless while the cable lies at the bottom in deep water, for of all the ticklish things to hold and raise a heavy cable is about the worst.

In other ways the importance of electricity is being pointed out by this war with Spain, and we look for many developments tending to raise the level of the electrical work in the army and navy. Besides, new ideas will fructify rapidly. Take for example the illustration of the use of wireless telegraphy at Madison Square Garden, where both Cuban dynamite guns and submarine mines are fired off by that agency. From the small scale to the large is easy in this instance, and the ability to dispense with intervening wires is an enormous gain. The one difficulty that suggests itself to us is that of testing the distant circuit of the explosive apparatus, but there must be ways of meeting that point.

Meantime we are glad to note that telegraph and telephone are playing their part bravely, and that with such material as bimetallic wire bare circuits on wet grounds are proving extremely useful. Moreover, the phonograph is now seriously suggested as a safe and good means for sending dispatches. Let all these new things be tried, and many more. Some will fail, but many will work, and the nation that has them will be all the stronger in matters of offence and defence. Capt. Eugene Griffin has perhaps taken one of the best practical steps in his recent letter to the Secretary of War analyzing present conditions, with the result that a volunteer regiment of 750 volunteer engineers is being raised. The engineers' regiment will probably be used largely for coast defence and harbor work. It is the intention to have it representative of all branches of the profession, and it is to embrace civil, mechanical and electrical engineers, practical electricians, mechanics, artisans, draughtsmen and men familiar with all kinds of engineering work, all capable of being rapidly converted into military engineers with proper training.

In his letter to Secretary Alger Capt. Griffin pointed out that toward the close of the Civil War the engineer troops numbered about 5 per cent. of the strength of the armies, respectively, of Grant, Sherman, Thomas and Meade. The character of the country in Cuba and the probability of siege operations against Havana, he thinks, make necessary an unusually large proportion of engineer troops with the army of occupation. The proposed engineer brigade, he adds, like the engineer troops of all armies, would be armed and drilled as infantry, and would be quite ready to take its place in the line of battle in case of necessity.

Electricity on the Broadway Line, New York.

FOR many years Broadway was sacred against the invasion of the street cars. It is true that stages both spectacular and dingy haunted the thoroughfare through a long period, but the mere suggestion of tracks was anathema. But the growth of business and pressure of travel made a street car line desirable and inevitable, and after a lot of talk about an underground road, the famous "grab" was made by Jacob Sharp and his political crew, and the regime of the horse car began. This proved so successful that the cable came, although electricians all insisted that it was a mistake not to look a little bit ahead and put in electric traction. The cable has done its work fairly well, but can no longer hold its own against the brilliant demon-

stration that the electric underrunning trolley conduit system is now making on Madison, Lenox, Amsterdam avenues and on West One Hundred and Sixteenth street. The news is now given out that consents are being very freely granted by the owners of property along Broadway for the change to electricity, and that the General Electric Co. has the order for the equipment, which will correspond with that on other lines. As Mr. J. D. Crimmins says: "Electricity is preferable to the cable for many reasons, as patrons of the lines know. There is less shock in starting and stopping, less liability to stalling; and it is more economical. On account of its manifold advantages it will be but a short time until the underground electric system will supersede the cable as the cable has superseded the horse." This prophecy is already so far along in fulfilment that there is already relatively little cable road left in the United States.

Vacuum Tube Lighting.

ELECTRICAL engineers as well as laymen find the subject of electric illumination still as absorbing a topic as it was some twenty years ago. At that time the arc and incandescent lamp were prominently before the public, and many looked upon them with the eyes of skeptics, among the most pronounced unbelievers being many prominent electricians themselves. But arc and incandescent lighting passed through the ordeal and stand to-day far and away ahead of all of their competitors. We may be mistaken in our view of the situation, but it seems to us that the present period parallels in a marked manner the conditions which existed at the time mentioned above, and which are now applicable to vacuum tube lighting. Up to within a quite recent period vacuum tube lighting has been a thing of the laboratory, to which many eminent inventors have given their thought and energy. The reduction of the system to a fairly practical basis was the work which Mr. Moore set before him and the first fruits of which were shown at the Electrical Exhibition of 1896. That demonstration, crude as it was, we believe was enough to have indicated to the unbiased mind that there was "something in it." That Mr. Moore evidently thought so is shown by the fact that since then he has kept at it without the slightest let-up, with the result that he is to-day able to show what few would have thought possible a short while ago.

A description of the lighting of the Moore chapel at the Exhibition, which appears elsewhere in this number, seems to us, therefore, worthy of more than passing notice. This chapel, we firmly believe will be the forerunner of many vacuum tube light installations, both private and public. As to the practicability of the system as installed at the Exhibition, there seems to be but little doubt. Mr. Moore has worked out his details with much cleverness, and when one contemplates a structure lit continuously for hours at a time without a break by means conforming to the present standard system of wiring, including interior conduits, one is bound to admit that vacuum tube lighting is a factor that must be dealt with seriously, whether we will or not. By this we do not mean to imply that Mr. Moore's system has been brought to a stage beyond which improvement is no longer possible. To maintain this would be equivalent to saying that the incandescent or arc system of lighting were no longer capable of improvement. It is certain, however, that Mr. Moore's system at the present is at least in as perfect a condition as was the arc lamp in 1876 and the incandescent lamp in 1880, while we are not so sure but that it is even now in better condition for practical work than the other systems were at the period mentioned. Considering that Mr. Moore has tackled the practical problem single-handed he is unquestionably entitled to great credit, which we believe will be accorded to him by those inventors who know what it means to develop an idea involving so many considerations to a successful realization in so short a time, and with far from unlimited means at his command. We congratulate Mr. Moore on the genuine progress shown by him, and trust that he will persevere in his pioneer work.

An Interesting Non-Municipal Street Lamp Report.

THE average reports of city lighting committees are not absorbingly interesting documents, but once in a while we come across one that gives us some real information. An example of such is the 1897 report of the Committee on Lamps of the city of New Haven, Conn., just issued. As the lighting of this city is in most intelligent hands a closer inspection of this report will prove of value to lighting committees and central stations as well. New Haven is lighted by three systems, gas, naphtha and electric; there being 442 arc lights, 105 Welsbach, 633 plain gas and 512 naphtha lamps. All lighting is done by contract with private companies. The city is now paying $98.55 per arc light of 1,200 c. p., the electric lights being lighted at dusk and extinguished at dawn every night in the year, thus covering 4,000 hours of burning. Regarding the question of complaints due to outages, etc., we notice that from these various causes gas gave rise to 1,168 complaints, naphtha 709, electric lights 401. Quite a marked percentage of these complaints were due to the effect of a high wind last November, in which, however, the electric light showed up remarkably well. While none of these were out or broken, the Welsbachs showed one out, plain gas showed eight out and one broken, while naphtha showed 77 out, for that one night. During the whole year 278 lamps were reported out at various times, of which 50 occurred in a single night during February, 1897, when one of the circuits was broken by a falling tree during an extraordinarily high wind. Considering that the total number of electric lamps is 442 burning every night, and that only 278 lamps were reported out during the entire year, the record is a very good one. That the service must have been excellent is strongly evidenced by the fact that the entire amount deducted during 1897 from the bills of the electric light contractors was only $21.33.

In his very able comments on the figures presented, Mr. Henry Hopkins, Superintendent of Street Lighting of New Haven, states that the service rendered by the electric lighting contractors has been of a high grade. Mr. Hopkins also has something to say on municipal ownership of electric lighting plants, and as we believe his motives will not be questioned by any one who has followed his career, his opinion is worth recording. Mr. Hopkins says: "From what data and facts I have been able to obtain on both sides of the subject, I would say, that until the time comes when more information and accurate facts can be obtained, it would not be good business policy to enter into any such project. The recent showing up of the Philadelphia Municipal Gas Works amply sustains my belief, and ardent supporters of municipal ownership must have received a severe shock. And it is only one of many cases that could be quoted." Coming from a city official, this is a most encouraging sign that there are still many clearheaded men in municipal employ in this country.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work—IX.

BY A. E. DOBBS.

HOW TO CROSS CONNECT ON TERMINAL POLES, ETC.

Some linemen, in running the cross connecting wires on a pole—as from a cable box or changing the position of line wires—like to tie and lash them all together with twine or tape till they have a cable as smooth and stiff as a new rope. Now, this makes very neat looking work, but it is sometimes quite a bother in more ways than one. In the first place, suppose it becomes necessary to change a conductor, as is often the case. To do this the lashing must all be untied, or cut, leaving the whole mass in a disordered condition, and once in this condition it is apt to be left so.

Again, with the wires bound tightly together the insulation is

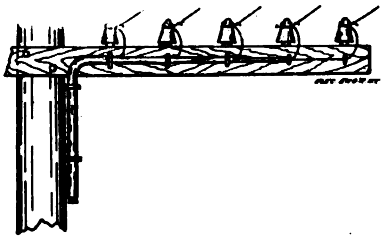


FIG. 32.

lower, and sometimes breaks down altogether, to say nothing of its retaining moisture after a rainstorm, and glueing together in hot weather. When it is necessary for wires to be bunched, the more loosely they lie together and the more free air surrounding them, the better the insulation will be.

The best way to do such work is to run the wires in such a way that each individual one can be traced out, pulled out, or inspected, and Fig. 32 shows such a method. First, on the pole and on the arm next to the pole drive gas-pipe staples, at distances of 12 inches apart, and pass the wires through them. One of these staples will hold 50 wires without crowding very much, or if more than 50 wires are required, larger pipe straps wound with tape will answer; but two rows of staples, one for each side of the pole, will accommodate 100 wires easily, unless the insulation is very heavy. When the arm is reached, drive one staple on the side of the arm, under each pin; and for the three outside pins, galvanized fence wire inch-and-a-quarter staples will hold three or four wires, and are therefore large enough. Where double arms are used, keep the staples on the inside, where they will be out of the way.

Never run the wire across the top of the arm, except at the insulator pin, as otherwise it will be trampled on, and the insulation worn off and perhaps broken.

Most linemen like to take a turn or two of the wire around the insulator, as in that way they have some slack wire if they need it, or enough to make another connection if broken or changed. It is best not to make this connection directly on the line wire. Instead, when the line wire is fastened to the glass, leave an inch of the end stick out, and when the copper wire is brought up, fasten and solder to this end; and turn it down alongside of the insulator. By so doing the line will not be weakened by rust at this particular spot, as is often the case. Some construction men use a connector, like a battery connector, at this spot; don't do it, it will make trouble.

Wire for this kind of work should not be smaller than No. 19, and either triple braided weatherproof, or rubber covered and braided. Never use office or annunciator wire for outside work.

TREE TRIMMING.

One of the greatest annoyances to the telephone man are trees, especially as permission to trim them cannot always be obtained. The use of insulated wire does very little good, as the insulation is soon worn off. Where there are 20 or more wires it is generally cheaper to run a cable low enough to pass under the heavy limbs, with junction boxes at 500-foot intervals, for local distribution. In this way, more than one arm will not be necessary.

When trees have to be trimmed, do not be satisfied with lopping off the twigs and ends of the branches, for next year the tree will be as bad as ever, and besides, its appearance is anything but artistic. Send a man up and cut the branch off close to the trunk and cover the end with paint, and it will make no further trouble. Many a time the tree can be trimmed so as to not only clear the lines, but look as well as before.

CABLES.

While it is taken for granted that cables will be used from the office to the different leads, they are also, many times, a necessary part of pole line construction. While not affording as good insulation as ærial lines they are more sightly and convenient than an equal number of bare wires could possibly be, and they also reduce the trouble account very materially; are not influenced by wind nor often by sleet storms and once properly put up and tested out make no further trouble till they wear out, which generally takes a long time.

On streets where trees are numerous and troublesome the only satisfactory service for a large number of wires is cable service, with distribution boxes at places most convenient, and with only one or two arms on the poles, for local distribution. One case we can recall especially where 14 or 15 arms were replaced by a cable of 204 wires is worth mentioning:

The cable was run out nearly half a mile from the office, till the distributing centre was reached and a great many wires were taken off, when it changed to a cable of 102 wires, and about a mile from the office was replaced by one of 52 wires when the suburbs were reached and the rest strung out with wires in the usual way. At every second corner the cable was looped into a terminal and both conductor ends brought to, and united at the terminal posts, as shown in Fig. 33. Thus every conductor could be found and if need be tested and used at each box. (In some cases of this kind a certain number of pairs only are taken into the terminal posts, say, from 1 to 20 at the first box, 21 to 40 at the next, and so on; but the best plan is to bring them all in, where they can be used for party lines if necessary, or tested back, in case of an "open," or even cut out in case of a "ground" beyond the box.)

Previous to this the service on this particular lead had been

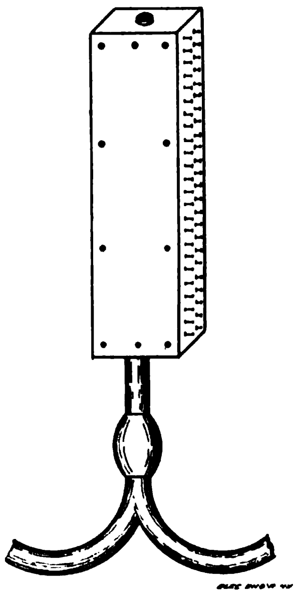


FIG. 33.

anything but an ideal one, but with the cable it seemed to leave nothing to be desired. We have seen cables run through residence streets suspended to trees with a short pole used occasionally to help out the distribution, thus carrying from 30 to 50 wires in places where pole line work would have been impossible. Here is a hint for our electric lighting friends. In many places such as this, a duplex lead covered cable would give better service than the flimsy insulation that is much used on overhead line wires at present. Trees and light limbs then need not be feared, and much three trimming and other troubles be avoided. While there are many different makes of cables, there are only three kinds in general use.

In some, and the earliest forms, the conductors are covered with rubber or gutta-percha compounds, such as Okonite or Kerite.

These furnish good insulation and are much preferred in telepragh, or electric light work, but they are not the best for telephone work generally, because their electrostatic and inductive capacity throws in retardation and cross talk. They should therefore be used only in short lengths though the objection to them is sometimes partially met by wrapping each separate pair (nearly all cable conductors are twisted in pairs) with tin or lead foil which is grounded in the office or to the common return.

Lightness, flexibility, and ease of handling are the desirable features of this class of cables.

Another of the older methods of insulation consists of cotton or jute thread soaked in either asphaltum, Ozite, paraffine or creosote, protected by lead armor which shields the conductors against outside induction. This lead armor is also grounded in the office or sometimes takes the place of the common return, its bulk making its resistance negligible. Last, but not least, we have paper either dry or paraffined and lead covered. The best insulation for electrical conductors is dry air, and a special kiln dried fibrous paper furnishes the nearest approach to air at anything like reasonable cost.

But while dry paper is the best, it is also a source of weakness, for it will absorb dampness very rapidly if exposed. To prevent this, the ends for a few feet back are generally filled with pitch or paraffine, sometimes hardened with rosin, or beeswax, to prevent absorption of moisture when the cable is opened.

In some cases, however, where there is a great deal of underground work, and the work of handling cables is well understood, these compounds are left out even at the ends, the joints or terminals being quickly put on and paraffine poured over the joints only, to drive out the trifling amount of moisture that may have accumulated. But the body of the cable being simply kiln dried paper, it is easily seen that a very slight puncture in the lead covering means dampness and low insulation. And let us say right here that when a cable has been left open an hour or so, and boiling hot paraffine poured into it, the bubbles arising in the liquid will show that some moisture has been absorbed, even on a very dry day.

Persons not familiar with cable work, had best not undertake to put up a very large amount of it, and it would probably be cheaper in the long run to arrange with the manufacturers to send some one to supervise the work, unless certain that the force on hand can manage it. In New York City it is usual to let the contract to the cable company direct and require a thirty days' test, the tests being carefully made and severe.

Still a few hints on the subject may not be amiss.

Aerial cables cannot be handled too carefully. Don't forget this, or let the men forget it. Do not pull a lead cable over the arms and leave it hanging there, as certain farmers have been known to do; perhaps under the impression that they could treat it the same as if it were a trolley feeder.

As it does not improve a cable to have men tramping over it, try and keep it out of their way by putting it in places where they won't have to step on it in getting up and down the pole; put it far enough out to allow them to get by it, say, outside the nearest pin.

Keep a sharp lookout for punctures and instruct all hands to do the same. See that all nails, and cleats or anything liable to injure the cable are removed from the inside edge of the reel. Do not let the men open a cable out of doors—or indoors for that matter—after one o'clock, unless sure they can finish it that day, for a cable once unsealed should be finished and sealed again as quickly as possible. Once upon a time some men opened a cable to put on a terminal head at 4 o'clock p. m. At 6 o'clock it was not half finished, but they went home for the night, leaving the terminal uncovered, and slept the sleep of the just. Mist in the early part of the night; and a northeast rain and snow in the latter part, and a well soaked head. (A cable head is not benefited by a soaking even in ice water.) Several bad conductors, cross talk between every one of them, and more from the subscribers. And the man responsible for all this, with the nerve of a train robber, tried to get an extra discount from the company that furnished the cable on the ground that the cable was no good in the first place.

The first thing to be done before putting up a cable, is to hang the suspension wire. This may be as small as No. 6 for short spans or No. 4 for spans not exceeding 100 feet—that is, for 100 wire lead covered cable—but the best span wire is a manufactured cable composed of seven strands. These strands should not be smaller than No. 12, and for spans of 150 feet, seven strands of No. 10 is about right. Of course the terminal poles at each end of the cable must be guyed beyond the possibility of their giving way, for if not drawn tight the span wire will soon begin to sag under the weight of the cable, and while a sagging cable will probably give as good service as any, yet it has a disreputable look and work of this kind leads to a demand for underground construction. If the overhead work is all it should be, there will be no demand for underground work, except in the largest cities.

Do not try to pull out a 2,000 foot length of cable from one end and expect to have it free from trouble, as the strain on the cable will require a team of horses to draw it before it gets through. If thought desirable to draw out 2,000 feet in one piece, which is not advisable except by the most experienced men, place the reel at a point one-third the distance to the terminal pole, and when that is drawn out and suspended draw the rest off the reel, coiling it on the ground in the form of a figure 8 twenty or more feet across, this being done to prevent kinks. Then start the inside end back the other way. In some places the cable may be all laid out on the ground and the hangers put on there. Then raise the end to its position on the pole and a man in a boatswain's chair can follow the span wire and hook it on.

The chair may be suspended from a snatch block which travels over the span wire, the block being one that can be opened at the side and changed as the poles are reached. If the hangers are of a kind that can be readily put on by hand—as clip hangers —another snatch block carried on the span wire by its hook with the cable passing over the pulley and pulled ahead from the next pole will lift it up so the man in the chair can handle it, the chair being also pulled along. But the most common method is to have men enough to man each pole, put on the clips as they leave the reel, and as fast as they come up the man on the first pole hooks about every fourth or fifth one on the span wire and when the next pole is reached a man there unhooks them, passes them around the span wire support and hooks them on again, the same operation being repeated at every pole—note if malleable iron hooks or clips are used; they should be placed about 18 or 24 inches apart. As the last section is being pulled in, every hook is then placed on the wire so that when pulled through that part of the work is done.

Another method much in favor with some companies is to pull the cable through in snatch blocks placed every 50 feet apart and hung from the span wire afterwards, suspending it with marlin yarn or wire. In New York City marlin is used, in Brooklyn No. 14 steel wire. This is wound on with what is commonly called a spinning jenny; it consists of a hollow wooden cylinder split in two parts and large enough to cover the cable and span wire. It is brought together over both the cable and span wire and wound on the outside, with marlin enough to reach the next pole. The marlin end is then securely tied around the cable and span wire and the jenny rapidly pulled through to the next pole with a rope, the yarn slipping off as it is pulled along. At the next pole what remains of the yarn, or wire, is taken off and the operation repeated till all the cable is in place. It is claimed for this method that the cable lasts longer than when hangers are used.

In estimating the amount of cable required, always allow for a few feet extra at each end in order that it may be bent down the pole and brought up into the terminal box. It is also best to cut off two or three feet from each end, as that part of the cable is apt to be bad.

The cable should be brought into the box from the bottom, as also the connecting wires, in order to keep the inside of the box as dry as possible. The inside of the box should also be painted with either shellac, or asphaltum—P & B is one of the best asphaltum compounds for this purpose—for the same reason.

If the cable is a long one, ground strips and lightning arresters will be necessary, so that the box should be made large enough to include these.

The cable companies nearly always furnish compounds for filling the terminal head, but if this is not at hand a mixture of paraffine and beeswax will answer very well. Pour in boiling hot

Wires with connections inside the head should be soldered, as a general rule. There is a solder that is made up in thin hollow strips, with acid salts in the centre, that is best adapted for this work. As the wires will nearly always be found in twisted pairs, arrange to keep them together in regular order, so that the mate to any conductor can be found, when it becomes necessary to run metallic circuits.

Bell Telephone Output.

The American Bell Telephone Company's statement of the output of instruments for the month ended April 20 shows:

	1898.	1897.	
Gross output	29,254	20,426	Increase.... 8,828
Returned	13,139	7,245	Increase.... 5,894
Net output	16,125	13,181	Increase.... 2,944

From December 1 to April 20:

	1898.	1897.	
Gross output	109,921	73,735	Increase....36,186
Net output	58,224	45,579	Increase....12,645

This is a very heavy gain.

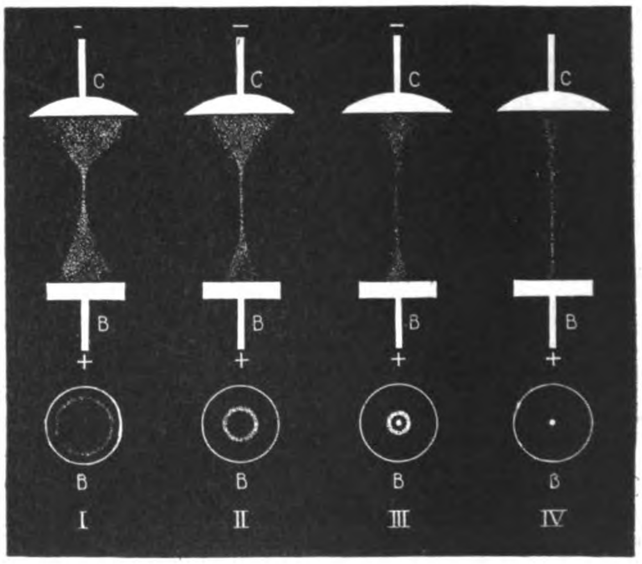
Adjustible X-Ray Tubes.[1]—I.

BY A. A. C. SWINTON.

THE Crookes's radiant matter tube, in some form or other, affords the only known means by which the Röntgen rays can be generated, and it is, therefore, perhaps not altogether inappropriate that the first ordinary paper communicated to the Röntgen Society should deal with the design of tubes of this description. As most of those who worked with the various forms of tubes originally employed for producing Röntgen rays will not readily forget, these had many imperfections, and there can be little question that the first real advance after the announcement of Röntgen's discovery, was Mr. Herbert Jackson's adaptation of Crookes's focus tube to X-ray purposes. The focus tube gives a quantity of X-rays not obtainable with the older forms. It is much less liable to be cracked or injured by the heat of the discharge, while as theX-rays all proceed from a very small area, a degree of sharpness is attained in the resulting screen-image, or photograph, that was previously quite unobtainable. The focus tube as originally introduced, though a vast advance on all previous arrangements, is not without its imperfections. Dr. MacIntyre was, I believe, among the first to call attention to the importance of using electric discharges of great electrical quantity in order to produce the best results. These heavy discharges give a much brighter screen, or what is the same thing, they enable photographs to be taken with much shorter exposures. They also cause the X-rays to be more penetrative, but at the same time they are very hard upon the tubes. With the focus tubes of the original form, heavy discharges will frequently twist up or even melt the platinum, and will usually make it red or white hot. This leads to blackening of the tubes, and to a gradual increase in the resistance, till eventually no discharge can be got to pass.

Recognizing these defects, I set myself some little time ago, in conjunction with Mr. J. C. M. Stanton and Mr. H. Tyson Wolff, the task of investigating the action of the focus tube, with the idea of, if possible, improving the design, so as to admit of heavy discharges being employed, with the view of obtaining easily and continuously the most active and penetrative X-rays possible. At the same time, seeing the great variation of the character of the X-rays that occurs with very small changes in the degree of exhaustion, and the practical difficulty of obviating such changes in practice, I endeavored to discover some ready method of adjustment more certain and more easily worked than the auxiliary pumps, potash tubes, and other similar appliances that had at that time been used or suggested for this purpose.

When a focus tube is carefully examined while under the process of exhaustion on the mercury pump, the form of the cathode discharge is found to alter from the initial appearance shown between the cathode C and the anti-cathode B, in Fig. 1, at a low vacuum, through the appearance shown in Figs. 2 and 3, to that illustrated in Fig. 4, which shows the appearance when the vacuum is high. As will be observed, the cones of cathode rays in each case converge from the cathode cup to a focus, and then diverge again on the other side of the focus to a less and less extent the higher the vacuum. Finally, at a high degree of exhaustion the cathode discharge does not appear to diverge again very perceptibly, at any rate within a moderate distance, but continues in a thin line. It is when this stage of exhaustion is reached that Röntgen rays are given off in their most active and most penetrative form. Experiments show that both the convergent and divergent cones of cathode rays are hollow, and not solid in section. When the concentrated cathode rays are allowed to fall upon a disc of ordinary electric light carbon, the latter exhibits surface luminescence. Except, however, when the disc is exactly at the focus, in which case it shows a bright luminous spot, the intersection of either cone by the disc gives not a solid spot of luminescence, but a hollow luminous ring, which decreases in diameter the higher the exhaustion, as shown in the lower portion of Figs. 1 to 4. It appears further that the cathode rays are not given off from the whole surface of the cathode cup, but only from a ring-shaped portion, the diameter of which is less and less the higher the exhaustion. This, perhaps, explains the reason why very large cathodes give no better results in producing X-rays than comparatively small cathodes. Indeed, at the degrees of vacuum necessary to produce penetra-



FIGS. 1, 2, 3 AND 4.

tive X-rays, the greater portion of a very large cathode is apparently ineffective, as the discharge seems to come off entirely from a very small part of the central portion. This is not readily seen with the usual cathode cups of aluminum, but with cups of carbon it is easily observed. Full details of the experiments from which the above facts are derived, will be found in "The Proceedings of the Royal Society," Vol. LXI., pages 79 to 95.

Cathode rays are generally believed in this country to consist of atoms or molecules of residual gas, which being similarly electrified to the cathode, are repelled by the latter, and travel at an average velocity not much less than one-twentieth that of light. It is obvious, however, that upon such a theory the precise average velocity must depend both upon the exact potential of the cathode and molecules at the moment the latter leave the former, and also upon the degree of exhaustion of the tube, upon which depends the free path of the molecules—that is to say, the distance a molecule can travel before coming in contact with another molecule. Years ago Crookes showed that the deflection of a cathode beam by a magnet depended upon the excitation of the cathode, and upon the degree of exhaustion—that is to say, the deflection was less the higher the velocity of the molecules. More recently Birkeland has produced what he calls "the cathode ray spectrum," from which it appears that the

[1]A paper read before the Röntgen Society, London.

cathode rays are not homogeneous but heterogeneous, some being more easily deflected than others, so that when the cathode stream, passed through a slit, is deflected by a magnetic field, and is then allowed to fall on the glass and cause fluorescence, the result is a series of bands. These bands are in a perpetual state of movement, and the conclusion is obvious that the molecules that form the cathode stream are not all moving at the same rate, but owing to the pulsatory and oscillatory nature of the electric discharge and the varying electrification of the cathode are divided up into groups, which have different velocities, and, being for this reason differently deflected, strike the glass and cause fluorescence in separately localized bands.

Now, as Prof. S. P. Thompson first pointed out, and as all who have since observed the effects produced on a fluorescent screen while a focus tube is in process of exhaustion, and is at the same time being excited, are aware there are several different stages as regards the X-rays produced. First of all, at less than a certain vacuum there are no X-rays; next, as the vacuum increases, X-rays show themselves, but of a quality that will do little more than penetrate the backing of the fluorescent screen. As the vacuum is further increased the rays become more penetrative and show the bones in the hand. Next a point is reached, when the flesh of the hand seems to be almost completely transparent, while the bones are almost entirely opaque; at still higher vacua, the bones becoming more and more transparent, the contrast between bones and flesh becomes less and less, till at length, at the very highest vacuum at which the discharge will pass, the bones scarcely show at all, owing to their having become almost as transparent as the flesh, and the whole hand throws but a very faint shadow on the screen.

Again, what I have termed the "penetrative value" of the rays is found to be dependent upon the applied electromotive force, that is to say, the difference of potential between the cathode and anode, and the conclusion seems to be irresistible that on the assumption that the cathode rays consist of rapidly moving molecules, which by bombardment of the anticathode cause X-rays to originate, that the penetrative value of the X-rays depends upon the velocity of these molecules at the moment they strike the anticathode, and to the difference of potential between molecule and anticathode at the moment of impact, or to one or other of these conditions.

I must again refer to Prof. S. P. Thompson's experiments as to the value of different materials for the anticathode, as he was, I believe, the first to discover that the higher the atomic weight of the material the better the result. Further experiment, however, shows that while what I may call the quantity of X-rays produced as measured in terms of the brightness of the fluorescent screen, or in inverse terms of the length of exposure necessary to impress to any given degree a photographic plate, is largely dependent upon the material of the anticathode being greatest with anticathodes of the highest atomic weight, the penetrative value of the rays—that is to say, their powers of penetrating opaque substances—is independent of the material of which the anticathode is constructed. For further particulars on this subject I may refer inquirers to "The Proceedings of the Royal Society," Vol. LXI., pages 222 to 226.

To come now to more practical matters, metallic uranium, which is the element with the highest atomic weight (240) is commercially unobtainable at present. It is to be hoped that this state of affairs will not continue, as in addition to uranium being probably the most efficient emitter of X-rays, it is also stated to have the great further advantage of not blackening the glass, even after prolonged use. Thorium (atomic weight 231) and thallium (203) being also commercially unknown, and bismuth (208), lead (206), mercury (199), and gold (197), being too easily fusible, platinum with an atomic weight of 194, and a very high fusing point, is the best obtainable material for the anticathode surface.

As platinum is, however, expensive, and thin sheets are apt, if unsupported, to be fused, pierced, or deformed under the bombardment and intense heat, I have found it desirable to mount the platinum disc on a larger and much thicker disc of cheaper metal, which not only supports and prevents mechanical deformation of the platinum, but also acts as a dissipator of heat, in addition to lessening the blackening of the glass, owing to there being only one platinum surface exposed.

In the tube I have now in my hand, which was the first constructed in my laboratory on this plan, the platinum is simply a piece of foil soldered with silver solder upon one side of a penny. Copper or bronze are, however, not good materials to introduce with a high vacuum tube, for as will be observed from this specimen, which has been a good deal used, they are apt, even more than platinum, to cause considerable blackening of the glass, and this blackening tends to increase the resistance of the tube to the electrical discharge.

A much better backing for the platinum is undoubtedly aluminum, but here the difficulty arises that it is very difficult, if not impossible, to solder platinum on to aluminum, and a good contact between the two metals is necessary. A simple plan, and one that has been found very efficacious, is to make the platinum in the form of a disc—say, about 0.4 inch diameter, and about 0.02 inch thick. The aluminum may be 1 inch diameter and 0.25 inch thick, and upon the face of it there is turned a shallow circular depression, just of sufficient diameter to receive the platinum, but rather deeper than the thickness of the latter. The platinum is tightly wedged into this depression, the edges of which are slightly rivetted over the platinum by hammering.

It has been thought by some that there is an advantage in making the anticathode and the anode of an X-ray tube separate, the idea being that in this case there is less blackening. This idea I believe to be erroneous, provided the surface of the electrode which performs both these functions is sufficient to prevent heating, and provided, as is always best, a small spark gap is introduced into the circuit so as to stop out entirely the make current of the induction coil or any reverse oscillation in the discharge which otherwise would during their continuance make the anticathode the cathode for the time being. There can be no doubt, however, both for the permanence of the vacuum and also for the prevention of blackening, of the importance of preventing the overheating of the anticathode, and though the mass of aluminum I use and recommend is very efficacious in this direction, I am of opinion that as more and more electrical power is employed in order to obtain better and better results, some other arrangement for taking away the heat—say, in the direction of water or mercury circulation through the anticathode—will be found advantageous.

As already mentioed, one of the results of a red or white hot anticathode is a rapid deposition of platinum and blackening on the glass. This finely-divided coating of platinum occludes the residual gas and causes the vacuum to become too high. Heating the glass will to some extent restore matters to their proper condition temporarily, but, apart from the degree of vacuum, the blackening seems also to have an effect in increasing the resistance of the tube, which is very probably analogous to what Crookes discovered when he found that a non-fluorescent coating on the inside of a tube increased the resistance of that tube to the passage of the electric discharge.

The precise distance between the cathode and the anticathode is not of great importance, provided the degree of exhaustion is suitable, and provided the anticathode is beyond the focal point at which the convergent cathode rays meet together at low exhaustions. It is well, however, not to fix the anticathode too far beyond the focus, as this necessitates a higher exhaustion in order to obtain penetrative X-rays, and as too great a distance also impairs the sharpness of the resulting image.

The distance between cathode and anticathode has, however, a considerable effect upon the resistance of the tube, and upon the character of the X-rays it generates. In fact, adjustable tubes with which X-rays of any desired penetrative power can be obtained at will without altering the degree of exhaustion, or in which the unavoidable variations of vacuum which are found to take place in practice, can easily be compensated for, can be arranged with a movable anticathode mounted on a sliding rod, so that the distance between cathode and anticathode can be varied by gently tapping the tube.

MR. H. M. SALMONY, senior partner and managing director of H. M. Salmony & Company, Limited, of London, is here to take up electrical specialties suitable for the English and Colonial markets. His chief object is to take over sole agencies for alternate current motors, enclosed arc lamps, etc. H. M. Salmony & Company, Limited, are one of the largest electrical supply firms of the United Kingdom; they do not install plants themselves, in order to avoid competition with contractors. As a consequence they have over 5,000 contractors as customers on their books. This firm is therefore in the best possible position to represent American firms whose object it is to get a large turnover. H. M. Salmony & Company, Limited, have their own works in Birmingham, where they make some electrical specialties and chiefly electroliers, brackets, bronzes, etc.

Events at the Electrical Exhibition.

The Bell Telephone Pole.

It was quite interesting to note throughout the past week how the big electrical exhibition at Madison Square Garden pulled itself together and each night became more brilliant and beautiful, until the spectacle which presented itself to the eyes of the thousands of visitors on Saturday evening was indeed lovely and perfect. Of course, even now there are little touches being given, but rather by way of enhancement than of necessity. One exhibitor is not quite pleased with the look of his space and goes in for more decoration, or his neighbor puts in some graceful palms. Several of the makers of heavy apparatus have brought in new pieces, seeing how large the attendance is and finding a very ready inquiry for prices from the visitors, the quality of the attendance being very high. That so fine an exhibition should have been made, and licked into shape in less than a week, speaks volumes for the energies and courage of those leading the work. With "strikes" innumerable and with the country engaged in war, it might seem that the burden was too great, but the general manager, Mr. Marcus Nathan, "the little Napoleon of the Show" emerges finely from the ordeal. The Garden authorities who have seen many exhibitions are very hearty in their praise of the manner in which this has been organized and on its superb appearance.

The Electrical Engineer last week presented several pages of copious notes on different exhibits, with plans of the two chief floors. This week it begins its series of illustrated and descriptive articles on the leading commercial exhibits, many of these being on a remarkable scale of expense and importance, as the pictures testify. But in the meantime a number of auxiliary features have been got into shape and are a centre of attraction for crowds. These are chiefly in the Concert Hall and Assembly Rooms, and include there the charming Moore chapel, the model third rail system, Mr. H. V. Parsell's galvanoplastic exhibit, the testing apparatus from the Brooklyn Polytechnic Institute and Dr. S. Sheldon; and the historical wax tableaux in a series of eight groups. All these features we shall take up, as without exception they deserve the highest encomiums. But there are other features of interest everywhere quite outside the commercial exhibits. The New York Electrical Society has a cosy booth in a commanding position, and displays proudly not only the golden key loaned by Gen. E. S. Greeley, and now used by both ex-President Cleveland and President McKinley, but also the telephonic-phonographic speech of Vice-President Hobart, so that every passer-by can hear it. Mrs. Hobart and young Master Hobart have both been to the Garden and listened to it again, as they were in Washington when the original was sent, and wanted to see how accurately the Edison phonograph had done its work.

Adjoining the Society booth, the "Theatrophone" is in full swing, being the telephonic service from the theatres handled by the New York Telephone Company. Multitudes gather around nightly to hear the songs, marches, applause, etc., and the various exhibitors in the Garden have already worked out a pretty accurate time table, of the leading specialties, and a general movement from inside the booths to the long board indicates that something good is just about to be on tap.

Down on the main floor again is the fascinating exhibit of the field of force on a huge scale, by Mr. E. T. Schoonmaker, of Fordham, N. Y., on a white painted sheet of plate glass about 5 feet by 3, and supplemented by a number of his matchless "spectra." Around the corner again on the main aisle is the Edison magnetic ore separator exhibit, with its dainty separator model at work in sharp contrast to the huge blocks of iron rock, six or seven tons in weight, which the Edison crushing machinery at the mines smashes to pieces at one blow, as thoroughly as Dewey did the Spanish fleet at Manila.

Off the main floor again up in the Arena Circle is the complete electric printing establishment used on the opening night to print the messages and now in regular demonstrative operation. Just by, to show that if the pen is mightier, there are other things doing good work for liberty, is the Sims-Dudley Cuban dynamite gun, which is here fired with smokeless powder, emits a menacing whisper and discharges little flags and wads of Manila paper. Near by again is Mr. W. J. Clarke's improved wireless telegraph apparatus, not only ringing bells, etc., clear across the vast hall, but blowing up the submarine mines that have been planted by Mayor H. J. Smith under the cruiser floating peacefully beneath the lofty ærial electric fountain.

At the far eastern end of the hall is a fine electric cascade that is expected to be in full working order this week. When it was held up by the strikes and drunkenness of the men working on it, young Mr. Edison pitched in with all his father's vigor and grit. Some defective work broke three of his fingers for him, but he stuck at it persistently in a way that evoked universal admiration, although he had to undergo a severe surgical operation and is seriously disabled.

Above all the exhibits in the centre of the main hall hangs the lovely McIntire "arcolier," a distinct creation in large illumination, and an object admired by everybody, technical and lay. It is so airy and graceful, one forgets the weight and the number of lamps and pendants it carries.

Down stairs in the basement is the very fine generating and steam plant elsewhere referred to, and this is supplemented by the Engineering Picture Gallery, which already includes about 300 fine pictures with others still coming in. It was certainly a happy idea thus to render attractive the long passageways to the plants in operation, and no little instruction is derived from the gallery by hosts of visitors.

The present week is a very busy one at the Garden, as a number of new features have been arranged, now that the main Exhibition is off the minds of the management. The New York Electrical Society is beginning its course of popular lectures with one by Dr. S. S. Wheeler, on one of the special topics of which that well known engineer is a recognized master. The Stationary Engineers also gather at the Garden as guests of the management and the society. The week begins also with the starting of an X-ray exhibit for all, by Mr. W. J. Clarke, and with War Bulletins from all the leading papers, handled by Mr. C. Chamberlain, the Press Agent of the Exhibition. On Friday and Saturday comes the great Telegraphic Tournament organized by Mr. Fred. Catlin and Mr. J. B. Taltavall. Other attractions are also in hand, of really bewildering variety and extent.

These notes for the week must not close without mention of the novel effect on the tower, in regard to which we cannot do better than quote the "Evening Post" as follows: "The tower of the Madison Square Garden has often presented a beautiful spectacle at night, but it was surely never more a vision of beauty than since the Electrical Exhibition opened. With apparatus and by means which the management refuses to disclose, the tower each evening after dark is thrown up against the sky with a multi-colored radiance that causes every eye to be turned upon it, not only in the adjacent streets, but across the ferries and out well into New Jersey, and the Connecticut suburbs. The name that is already commonly given to this popular performance is "Diana's skirt dance." It really seems to be a huge representation of the Loie Fuller effects, with the aid of the wind, and of colored screens and searchlights. In waving columns of steam and cloud, some diaphanous material coils and curves around the shaft of the tower, right up to the foot of Diana, and then the tinted fires of electricity are let loose on this ever-changing scenic effect. At one minute the tower is all the colors of the rainbow; the next it is

a pearly white or blue, and then again it is all bathed in blood red, while at the same time a keen searchlight is thrown on Diana herself, as she points to the wind. Just below, of course, hangs the electric sign of the show, suggesting the wondrous things that are going on within the Garden itself; and thus a piece of advertising not less beautiful than it is clever accomplishes its purpose."

The Steam and Electrical Plant of the Exhibition.

AFTER having satisfied himself to his heart's content as to the wonderful advancement made in the application of the electric current, the visitor to the exhibition naturally wants to see how the current is actually generated and distributed. In order to satisfy this desire on the part of the patrons of the exhibition, and to convince them of the rapid strides that have been made in the steam generating and consuming apparatus as well as all other types of engines, a complete steam and electrical plant is in operation in the basement of the Garden. Two Babcock and Wilcox boilers of 265 h. p. each, built for the new plant of the Metropolitan Street Railway Co., were selected to furnish all the steam used at the exposition. The boilers are of the forged steel construction and were built for 200 pounds working pressure. They are in charge of Mr. M. Dardis. These boilers are supplied with undergrate mechanical draft by means of the Beekman system. This system consists of a steam driven fan automatically controlled by the Beekman system of valves. The air is delivered through deflecting dampers in the bridge walls under the grates into the closed ash pits. The principal feature of the system is the automatic regulation which controls the speed of the fan by the steam pressure in the boiler. When the pressure in the boiler rises above a desired point, a 6 x 6 engine slows down gradually and reduces the supply of air and the amount of steam generated. This portion of the plant is in charge of Mr. R. T. Mickle. The question of boiler feed-water is fully as important as the coal supply. The water of New York city being exceptionally well adapted for boiler use, no filters or purifiers were considered necessary. The pumps supplying feed water to the boilers are of the Henry R. Worthington Co.'s make, who have a splendid exhibit on the main floor near the main entrance. The steam pressure on the boiler is indicated on steam gauges manufactured by the Ashcroft Mfg. Co., New York., who have a very handsome exhibit in conjunction with the Consolidated Safety Valve Co. and the Hayden & Derby Mfg. Co. The Consolidated Safety Valve Co. are exhibiting "Richardson-Ashcroft" nickel seated pop valves, consolidated brass seated pop valves, farm engine, water relief, encased locomotive, muffler and side outlet valves and valves for marine use. The pop valves used on the boilers at the exhibition were furnished by this company. The Ashcroft Manufacturing Co. are exhibiting pressure and vacuum gauges of all kinds, Edison recording gauges, "Tabor" steam engine indicators, Coffin averagers, Moscrop speed recorders, genuine Packer ratchets, malleable iron stocks and dies, revolution counters, inspectors' test pumps and gauges, and gas proving test pumps and gauges. The Hayden & Derby Mfg. Co. are exhibiting the Metropolitan automatic, double tube and locomotive injectors, "H-D" ejectors, drive well ejectors, water heaters and strainers. The water supply for the boilers which furnish the power at this exhibition is furnished by one of this company's No. 14½ Metropolitan double tube injectors. The three exhibits are in charge of Messrs. Milton A. Hudson and Frank Andrews.

A description of this very modern steam plant would be incomplete without a mention of the fuel economizers which of late years have played so important a part in an up-to-date and efficient boiler plant. The Fuel Economizer Company, of Matteawan, N. Y., are exhibiting in actual operation a Green fuel economizer suitable for a 300 h. p. boiler. The scrapers are moved by a ¼ h. p. motor, which is claimed to be quite an improvement over the engine drive. The exhibit is in charge of Messrs. Wm. Downs, the New York representative, and Messrs. P. J. Challen and A. H. Blackburn from the main office and works at Matteawan, N. Y. Another interesting fuel economizer exhibit is that of Broomell, Schmidt & Co., Ltd., York, Pa. It consists of a 400 h. p. American fuel economizer 10 x 6 x 12 feet. It weighs 30,000 pounds and contains 98 tubes 4¾ in. x 9 ft. It is supplied with Broomell's improved engine driven scraping device, which is easily accessible and insures a close rubbing. There is a constant forced circulation of water through the heater. The exhibit is in charge of Messrs. H. Von Mengrenhausen, M. E. and A. P. Broomell.

The majority of the engines exhibited are direct connected to generators and comprise a great variety of types and sizes. Beginning nearest the boilers we find an American Ball engine, direct connected to a 25 kilowatt generator, built by the American Engine Co., and one 5 h. p. multipolar motor. A neat switchboard equipped with switches, measuring instruments and rheostat completes the exhibit, which is in charge of Mr. Jos. Englesby. The New York Safety Steam Power Co. are showing a 13 x 12 vertical automatic cut-off heavy duty engine with automatic lubrication, direct connected to a Fort Wayne generator. Then follow in the order given a 13 x 12 in. Armington and Sims engine, direct connected to a Walker generator; a 125 h. p. Fischer tandem compound, four-valve, automatic, high speed, self-oiling engine direct connected to a 75 kilowatt Onondaga generator; the celebrated Diesel motor; a 32 brake horse power horizontal "Hornsby-Akroyd" patent safety oil engine; a 70 h. p. Nash gas engine directly connected to a generator, and a 9 x 12 Woodbury automatic high speed engine of an improved type. This engine, exhibited by Burhorn & Granger, is direct connected to an Eddy 25 kilowatt generator made by the Stearns Manufacturing Co., Erie, Pa. These exhibits and many others which are found in the "Generating Section" of the exhibition will be described later.

The main switchboard of the exhibition was manufactured and installed by F. A. La Roche & Co. It consists of three panels, two being generator panels, one for the exhibition machines and one for the Edison service. The remaining one is the distributing panel. Mounted on the switchboard are the usual measuring instruments and switches.

From the above brief sketch it will be seen that the generating portion of the exhibition is one worthy of this magnificent enterprise and deserving of the most careful inspection of every visiting steam, mechanical and electrical engineer and power user.

Press Reception.

On Friday afternoon, May 6, Mr. Charles Chamberlain, the press agent of the Exhibition, and Mr. Marcus Nathan, the general manager, gave a reception to the members of the press and pointed out to them the main features of the exhibition. A miniature Spanish vessel was blown up by means of Clarke's wireless telegraph device, much to the amusement and gratification of those present. Moore's celebrated chapel was visited by a large number of the representatives.

The Underground Trolley Exhibit.

ONE of the most attractive and instructive exhibits at the Garden is that showing in detail a full size model of car and roadbed for the underground trolley construction of the Metropolitan Street Railway Company of New York with modifications by the Walker Company. The model consists of two rail lengths of track with the standard type girded rail 9 inches high and weighing 90 pounds per yard. Full sized yokes with manholes, frames and covers, with conductors mounted in place show up the method of insulation. A brick paving is placed on a portion of the roadbed, and the underground feeder conduits are placed at the side of the tracks. The conduits consist of 6 ducts imbedded in concrete. The tubes are three inches in diameter and were made by the H. B. Camp Co., of Aultman, O. J. G. White Co. were the contractors for the construction of the conduit.

A full size car of the Broadway type is operated forwards and backwards over the section. The car was manufactured by John Stephenson Co., Ltd., of New York. The body is 22 feet in length, and is equipped with various modern appliances consisting of revolving signs which are operated by means of a small hand wheel beneath the hood and under the inside deck of the car. The car is also equipped at each end with one of the Providence fenders of the model B type, of which over 700 are employed on the Metropolitan System of New York. The car is mounted on a Peckham truck of the Metropolitan special type, having gravity brake mechanism, and special yokes and double outer springs with counter springs beneath to prevent teetering. The wheels of this car were manufactured by the New York Car Wheel Works of Buffalo. The car is pro-

vided with electric headlights and with the Pitt patent gates, manufactured by the Pitt Iron Works Co.

The conduit being left open at the ends, the operation of the trolley or plow by means of which the current is transmitted to the motor is plainly shown. The supporting shank that carries the contact pieces is about six inches wide and one-half an inch thick, and is composed of two steel plates which enclose the conductor. The contact pieces are each about six inches long and are supported on each side of the main bar by horizontal springs. A pair of horizontal rollers is placed near each end of the bar which facilitates the passage of the plow around curves. The feed wires supplying current to the car are furnished and installed in the vitrified conduits by the J. A. Roeblings' Sons Company.

The New York Telephone Co.'s Exhibition Exchange and Display.

IMMEDIATELY upon entering the Garden the visitor catches sight of the splendid exhibit of the New York Telephone Company, which is located near the Madison avenue entrance and is intended to illustrate a private branch exchange system and a model pay station. In the company's space is placed a standard switchboard to which are connected telephones installed in the working departments of the exhibition and in the booths of the exhibitors throughout the exhibition hall. The switchboard also has a system of "trunk lines" connecting with the general telephone system. The various exhibitors are enabled to communicate with each other or with any station in the New York system. The Private Branch Exchange System, shown here, is adapted to large establishments of all sorts. A private switchboard serves as a connecting point for the trunk lines which run to the nearest exchange of the general system, and the lines which branch out from the switchboard to the various offices or departments of the subscriber's premises. This subdivision of the telephone service gives the very acme of efficiency in the conduct of the telephone traffic of a busy establishment. There is no confusion, no delay, no lost calls, and a large volume of traffic can be disposed of without friction. The Branch Exchange System is in use by about 200 large business houses of all classes. In no case has it failed to give complete satisfaction, and to produce an improvement in the service, conducted before with insufficient facilities at the subscriber's end.

The company also have on exhibition four "silence" booths similar to those supplied for the equipment of public or private telephone stations in New York; they are equipped with the different styles of telephone sets used by the New York Telephone Company. Another leading feature of the exhibition is the Theatrophone installed by the company. This consists of a novel single plug switchboard which has connected to it five prominent theatres enabling sixty persons to listen to the plays at any one time. Numerous telephone boys are in attendance and all questions about the working of the exchange are cheerfully answered by Mr. Herbert Laws Webb, to whom is due most of the credit for this superb installation, and Messrs. Wm. E. Huntington and S. D. Brewster, who are indefatigable in their intelligent efforts to serve exhibitors and inform the public.

THE NEW YORK TELEPHONE CO.'S EXHIBIT, WITH THEATROPHONE IN GALLERY, MADISON SQUARE GARDEN.

H. B. Camp Co.

This firm exhibits a very fine assortment of their vitrified clay conduits. The material is a peculiar clay mined in the neighborhood of the works, or it is a combination of different kinds of clay so that several varieties of conduit are manufactured, some being harder and designed to sustain a greater weight than others. The conduit is now manufactured in short sections, the standard being a three-inch inside diameter, with a shell about $\frac{3}{8}$ of an inch in thickness with the corners rounded off. The company also exhibit an old type of multiple duct conduit which they formerly manufactured, but they do not recommend its use, as it is not so convenient for repairs.

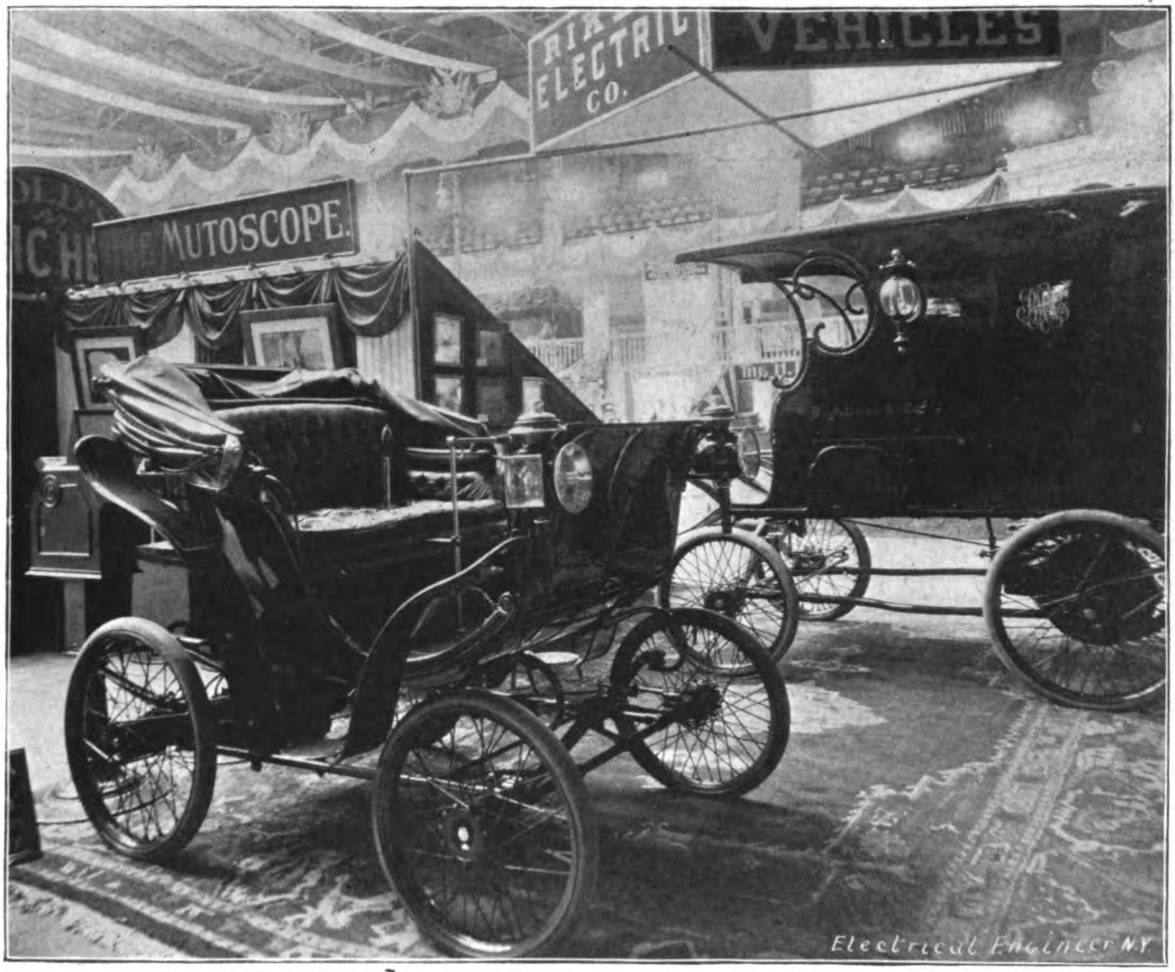
The standard construction is now a single duct conduit laid in concrete with sufficient concrete to separate the ducts and make the joints waterproof. Not only does the exhibit include the street ducts, but also elbows, tees and curved pieces. Among the special pieces are split ducts for repair work. These are manufactured solid, but there is a channel cut on each side so that when it is desired to split a piece for repair work it is easily done by rapping along the side of the duct with a hammer; there are also split tees and and other peculiar shapes. The conduit most recommended is one of dark color and is

made of a special mixed clay made from shale and clay. Besides the conduit proper samples of insulators for supporting the feeder cables on elevated roads are also shown. The company also manufacture fireproof materials for partitions and floors of office and other buildings and almost all products of this kind. The company are particularly fortunate in being located where the different qualities of clay are readily mined and there is also a six-foot vein of coal very near the works. Mr. Daniels is in charge of this excellent exhibit.

Riker Electric Motor Company, of Brooklyn, N. Y.

This company have on exhibition two types of their electric motor vehicles, the one a dry goods delivery wagon, which has been manufactured on an order for B. Altman & Co., of New York, and the body of which was built by Frederick R. Woods & Sons. The cab or body is richly ornamented, having the general appearance of the handsome delivery wagons employed by this company. These are four-wheeled vehicles, the rear wheels being 36 inches in diameter and the front wheels 32 inches, with pneumatic tires. A two horse power motor is employed which is geared to the rear axle, the motor and running gear and band brake being enclosed in a case. The weight of the body is equally supported on the four wheels and the steering is done by means of the front wheels, which are pivoted at the ends of the axle and are carried in either direction by means of levers actuated by a vertical spindle, having a handle which is operated by the driver. The controller is operated by the left hand and the reversing mechanism is operated by foot as is also the brake lever. In the steering handle is a button by means of which an electric bell placed under the foot board is sounded. On the foot board in front of the driver is placed a volt and ampere meter so that the condition of the battery is indicated for the guidance of the driver. The battery in the delivery wagon is placed under the driver's seat and part way back in the body, and may be removed or inserted through side panels which are easily removed. If the roads are reasonably level and in good condition one charge will propel the vehicle 25 or 30 miles. The total weight is 2,900 pounds, of which 1,000 pounds is assigned to the battery.

Besides the delivery wagon, a victoria is exhibited, which has already run over 3,000 miles. The batteries are charged from a 110-volt direct current circuit and are provided with an automatic cut-out so that the charging current is automatically cut off, when the batteries are fully charged. Besides delivery wagons the company manufacture traps, victorias, surreys and two or one passenger buggies.



THE RIKER ELECTRIC VICTORIA AND DELIVERY WAGON, AT MADISON SQUARE GARDEN.

The Peckham Truck Company.

Besides the truck exhibit with the model of the Metropolitan-Walker underground system and with the Walker Company's exhibit, the Peckham Truck Co. exhibit at their booth one pair of their new double trucks for long cars, known as No. 14 B. These trucks are so designed that motors are mounted outside the axles, allowing of a very short wheel base, that in the truck exhibited being four feet. Where one motor only is employed, its position outside the axle tends to so tilt the rear wheels that 65 per cent. of the weight is available for traction. The brake lever is so arranged that by the aid of a spiral spring the pressure on the wheels is in proportion to the weight that each one carries.

The extremely short wheel base limits the sway of the truck on the curves and permits of the body being mounted lower than it is possible to do with the ordinary trucks in which the wheels are all of the same size. The bolster is also constructed in a peculiar manner, giving great freedom of action of the truck on curves, without any tendency to derailment.

The truck on exhibition is one of twenty pairs that have been manufactured to fill a South American order, and is designed for a single G. E. 1,000 motor. This company also manufacture a maximum traction truck, as well as a series of trucks designed to suit any and all conditions of street railway traffic.

The Pump Exhibit of Henry R. Worthington.

THE well known firm, Henry R. Worthington, who have lately gone very extensively into the manufacturing of electrically driven pumps, have taken 1,000 square feet in the centre of the main hall, with an idea of showing at least one of each type of electrical pump which they build. Among others they show a horizontal duplex, having 11" diameter double acting pistons by 10½" stroke, driven by a 50 h. p. General Electric Company motor. The pump and motor are connected by means of a worm gearing which runs submerged in oil. This pump is intended for hydro-electric elevator service, and is a duplicate of one which has been in service for about two years. It is practically noiseless in operation, and is said to be a most satisfactory type of machine for elevator work. A 6x6 vertical triplex pump, driven by a 20 h. p. motor. This pump has three single acting outside packed plungers, and is intended for handling large quantities of water against comparatively light heads. The design is new, and the motor, which is carried on an extension bed-plate, is connected to the main pump shaft by a single reduction of spur gearing, the ratio being about six to one. A 3x4 horizontal triplex connected by a single reduction of gears to a General Electric Company motor, is carried on the same bed-plate as the pump. This is very compact machine, suitable for boiler feed or mine service. The plungers are outside packed and the valves are in separate pots.

They also have a 5x7x3 vertical triplex of the company's "steeple" pattern, connected by one reduction of gears to a General Electric motor. These pumps are designed for a water pressure of 150 lbs., and are fitted with differential plungers; that is, so far as the delivery is concerned each plunger is double acting, giving six displacements for each revolution of the main shaft, which ensures an even and regular flow of water through the delivery pipes.

They also show a number of their small electric pumps, suitable for house tank service, in operation, and connected with automatic tank switches which stop and start the pumps automatically, keeping a constant supply of water in the tank. These pumps are noiseless, the connections being made by belt, and not by gears.

Besides these they are exhibiting a small duplex pump, directly connected to a gas engine; an 8 and 12x9x10 compound direct acting air compressor; a 7½x16x10 vertical beam air pump; and one of their "Admiralty" pattern boiler feed pumps. This last pump is of the same design as those used on the U. S. battleships "Iowa," "Kearsarge," and "Kentucky."

They also show the '98 model of their regular pattern steam pump. This is an entirely new design, embodying many new features.

This splendid exhibit, shown in the illustration, is the largest and one of the most complete at the Exhibition and is in charge of Messrs. F. W. Jones, Jr., G. M. Maynard, and E. R. Howell.

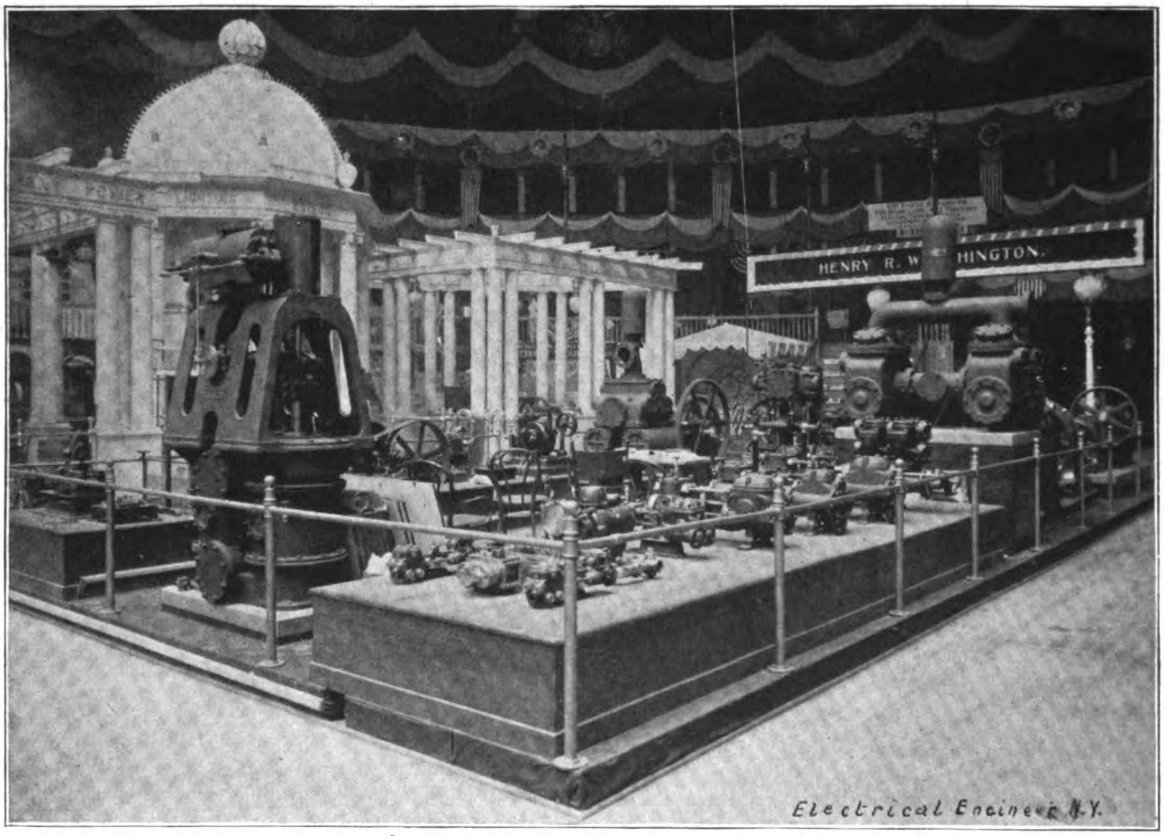


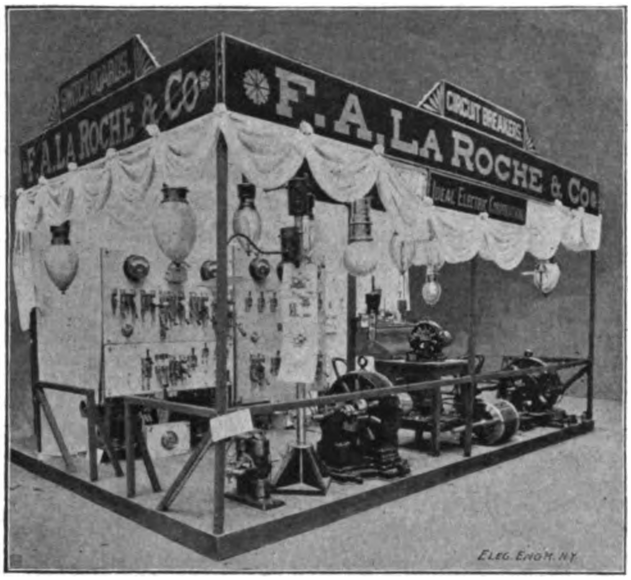
EXHIBIT OF HENRY R. WORTHINGTON AT MADISON SQUARE GARDEN.

F. A. LaRoche & Co.'s Exhibit.

ONE of the most attractive and complete exhibits at the Exhibition is that of F. A. LaRoche & Co. and the Ideal Electric Corporation consolidated. The firm show one of their modern switchboards, which is built for one of the large dry goods establishments in New York City. This board is of exceptional beauty; on it are mounted the well known "Ideal" circuit breaker and the LaRoche self-locking switches with Weston instruments and all other switchboard features, also a new and novel rheostat dial which is said to be the best thing on the market to-day. The board is made up of Knoxville grey marble, mounted on heavy angle iron frames with brass pedestals, and is one of the most substantial and businesslike boards in the Exhibition. The bus-bar work on the rear of the board is a fair sample of the class of work turned out by this firm who have made quite a reputation in that line in the past three years. They also have a switchboard containing ten "Ideal" circuit breakers, ranging in sizes from 25 to 2,000 amperes; as well as a single and double pole. This test board, as it is called, is mounted on angle iron frames attached to a motor and dynamo which are direct coupled, and the dynamo is wound to give 5,000 amperes, thereby showing the above switchboard in constant and practical operation; and one of the breakers, a 1,000 ampere break, was seen by the writer to break a circuit of 3,000 amperes without excessive heating or sparking. The manager of the firm reports that their factory is running 18 hours daily to supply the demand for their improved circuit breaker. The appearance and style and operation of the circuit breaker substantiate this statement.

The booth is handsomely decorated and is lighted by the well

known La Roche alternating and direct current arc lamps. It is well to mention a few advantages of this arc lamp: It is one of the simplest and most substantial arc lamp yet offered to the public, and the simplicity of the mechanism, the steadiness of the light and its economy should certainly commend it to all users of arc lamps. The central station manager would do well to inspect this lamp, as it is a lamp that will stand a great deal of hard usage and is not liable to get out of order owing to its simple construction. They are of the enclosed type for alternating current and are made up in a number of various neat designs. This firm also manufacture a focusing alternating current arc lamp which is a novelty in itself. They also manufacture the well known LaRoche alternating current dynamos, of which they show a complete line ranging from 1½ to 150 kilowatts. They also display quick break switches, as well as ordinary knife blade switches, which are made up of pure hard drawn copper, guaranteed to be free from all impurities. No castings are used in their construction. The self-locking switch



THE F. A. LA ROCHE & CO. EXHIBIT.

made by the firm is claimed to be the most practical switch yet offered to the public. The idea of the switch is that the act of closing it automatically compresses the hinge post and clamps the blade tightly between the clips of the hinge post, and there is an adjusting screw, so that any degree of compression can be obtained. The patent is owned and exclusively controlled by F. A. LaRoche & Co.

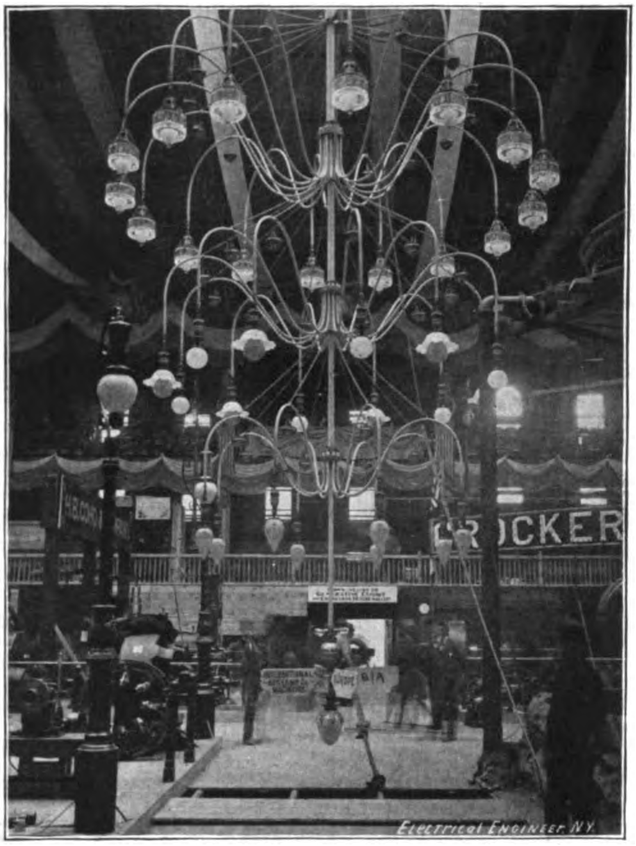
The firm manufacture numerous sizes of direct current machines as well as motor dynamos and rotary transformers.

It might be well to mention that the main panel switchboard furnishing the power and light for the entire Exhibition was manufactured and installed by F. A. LaRoche & Co., and the board was delivered in four days from receipt of order. The exhibit is in charge of Messrs. J. A. Loutey, A. E. Wells and F. A. LaRoche.

The Arcolier and Other Exhibits of the International Arc Lamp Co.

Of all the numerous novel appliances and apparatus shown at the Exposition there is perhaps but one which is so extremely new that a name had to be coined for it, which will on account of the admirable features possessed by its bearer, we are sure, soon become a "household" word in electrical engineering. "Arcolier" is the word which has been so happily chosen to designate the pendant of arc lamps, arranged as tastefully and æsthetically as are the incandescent lamps on the less brilliant and impressive electrolier. The honor of having designed and installed the first "arcolier," and one of gigantic dimensions, is due to Mr. Geo. R. MacIntire, who has designed numerous artistic arc lamp fixtures and globes. The "arcolier" consists of 37 enclosed arc lamps, giving a total of 40,000 c. p., and it weighs 1,500 pounds. The lamps consume from 4½ to 5 amperes at a pressure of 80 volts across the arc. To a motor in the base of the arcolier are attached four wooden blades pointing to the four quarters of the globe, which revolve slowly and add largely to the gorgeousness of the display.

Besides exhibiting the arcolier, the International Arc Lamp Company have the following lamps in operation at various portions of the Exhibition: Eight special lamps on cornice of Edison Electric Illuminating Company's temple and two ornamental post lamps at portals of same; two ornamental post lamps facing Madison avenue entrance, in the Henry R. Worthington exhibit; one ornamental prismatic pendant, Madison avenue entrance balcony; two ornamental post lamps, N. Y. Electrical Society booth; one silverine lamp pendant, The Electrical Engineer booth; one pendant, National Carbon Company's booth; two brass polished newel post lamps at speaker's rostrum; two service lamps, Nash Engine Company, basement; one polished brass pedestal at "Electrical World" booth; and one pendant, "Western Electrician" booth. The steadiness of the light and the beautiful designs of standards and pendants have won for Mr. McIntire and his company well deserved praise.



THE McINTIRE ARCOLIER AT THE EXHIBITION.

Keuffel & Esser Co.

This company make a very fine display of drawing instruments of every description, slide rules and recording machines, in fact, almost every tool that is usually sold for use by mechanical and designing engineers. There are also planimeters and a large assortment of Excelsior steel tape line together with field instruments and leveling poles. The exhibit also includes a blue print frame mounted on rollers and casters of peculiar construction and various stationery material used by engineers. There are also section liners, slide rules together with sextants, compasses, telescopes, etc. In another case are aneroid barometers, machinists levels, including a new level which has a double main bulb and a smaller right angle bulb; in addition there are mining compasses, pantographs, etc.

The number and variety of tools and appliances which are provided for operators in this branch of technical work, are strikingly illustrated by this exhibit. A novice would have no idea that so many useful instruments could be designed and shown in so attractive a manner as is shown by this company.

The National Carbon Co.'s Exhibit.

A very artistically arranged and interesting exhibit is that of the National Carbon Company, of Cleveland, Ohio. They show a great variety of their well-known products, principal among which may be mentioned the National Nos. 2, 3, 4 and 5 carbon porous cup cells, the Klondike and Le Clanche porous cells, special gas engine cells, varieties of cylinder

THE NATIONAL CARBON CO. EXHIBIT.

and Fuller type cells, gravity cells, back-plates, diaphragms, granular and globular carbon, lightning arrester plates, carbon boxes, plates, tubes and strips, filament blocks, special battery cups, carbon brushes, arc light carbons and smelting electrodes. The exhibit, which is shown in the illustration, is in charge of Messrs. Richard O'Connor and M. H. Moffett.

Gold Street Car Heating Co.

The electric heaters exhibited by the Gold Street Car Heating Company cover every style of electric heating device used for warming cars, houses, boats or buildings. All of these heaters are fitted with the Gold improved resistance coil and support, shown in the accompanying engraving.

As can be readily seen from the illustration this method of

THE GOLD ELECTRIC HEATER EXHIBIT.

supporting the resistance coil of an electric heater is quite novel. It is compact, simple, efficient and durable. A large amount of Gold's resistance wire is contained on this support and the very freest circulation of the air takes place through this coil at all times so that the highest efficiency is obtained, the distribution of the heat being always maintained in a uniform manner.

A large number of heaters are exhibited and they are all very handsomely designed; in fact it is claimed to be the largest display of electric heaters that has ever been put on exhibition and containing a great many different forms and styles adapted

METHOD OF SUPPORTING RESISTANCE COILS FOR GOLD HEATERS.

to the numerous requirements which the Gold Company have met.

The exhibit is looked after by Mr. Fred. Weston and Mr. H. E. Beach, the Eastern representative of the company. Mr. John E. Ward, the manager of the company, and Mr. Edward E. Gold, the president, are often in attendance during the evening explaining the merits of their improved devices to their numerous friends who attend.

The Hospital Service Exhibit of the American Electrical and Maintenance Co.

ABSOLUTELY new ideas are scarce in the electrical profession, but this exhibit is not only new, but unique. There are shown the appliances and materials used in the repairs of electrical machinery, which have become a very important feature in the kindred trades using electric current.

The American Electrical and Maintenance Company have

AMBULANCE OF THE AMERICAN ELECTRICAL AND MAINTENANCE CO.

systematized their branch of the business and have arranged a department for the special care of motors, dynamos and installations, in which they employ an experienced staff of inspectors who periodically inspect apparatus and take all risk of wear and tear of same for a small sum per annum, making good all worn or damaged parts, such as brushes, armatures, fields, instruments, etc. Moreover they keep specially for this purpose an ambulance which can be called out on special emergency work by a telephone message to 881 Franklin or 1398 Franklin. The shops of the company are situated in the most convenient situation at 451 and 453 Greenwich street, corner of Desbrosses street, New York, and are never closed, and at any time day or night it is possible to obtain a gang of men who are efficient to straighten out the most extensive of breakdowns.

No one using electrical power should miss a visit to their

exhibit and shops, as the latter is a permanent exhibition in itself. All classes of machinery are there repaired, and the company's plant is known among the trade as the "Electrical Hospital," which it is in every sense of the word.

The American Electrical and Maintenance Company is a continuation of the well known firm of A. K. Warren & Company, Mr. Aldred K. Warren being the president of the new company, who takes the active superintendence of all their technical work. The general management is in the hands of Mr. George Stanmore, who has been connected with the present and past firms for over five years; and their well known trade-mark, the White Cross, is a guarantee of good and quick service.

The Moore Exhibit at Madison Square Garden.

UNQUESTIONABLY the most popular exhibit at the Garden is that of Mr. D. McFarlan Moore. The crowds which this inventor's exhibit attracted at the last Exhibition in 1896, extensive as they were, are far outnumbered by the numbers which throng the Moore vacuum tube lighted chapel every day and evening. And no better indication of the practical advances made by Mr. Moore could be desired than the nature of the two exhibits referred to. The earlier exhibit, it will be recalled, consisted of a small enclosed booth, barely 10 feet square, with a dozen tubes arranged about the space, into which 20 persons could barely enter, and who had to make way quickly for those waiting in line behind them. The light tubes at that time were operated by Mr. Moore's vacuum vibrators, one to each tube.

The present exhibit of Mr. Moore may be said to be a radical departure and improvement in every way, down to the smallest detail. To begin with, instead of being cooped up in a mere cubby-hole, Mr. Moore has availed himself of a space upon which he has erected a chapel complete in every detail and in which he shows to perfection the manner in which vacuum tube illumination can be carried out in practice.

Ascending from the Lecture Hall the visitor is introduced into a passageway leading to the chapel along which Mr. Moore has sought to give the pilgrim a five minutes practical course in the applications of electricity, which is alluded to more fully below. Emerging from a bend in the passage the front of the chapel suddenly looms up a perfect reproduction of a stone village church, steeple, clock and all, Fig. 2. The front doors are open, above the arches of which shine forth in vacuum tube letters the words, "Moore Vacuum Tube Chapel." Within is seen the vaulted roof ribbed with veritable arches of light consisting of long curved tubes of glass about 2 inches in diameter and glowing their entire length with a pure white light. The harmony of the surroundings is everywhere observed. The ear is gratified with melodious strains from the magnificent pipe organ, which fills the far end of the chapel behind the altar fully equipped, even to the lectern. Specially designed quartered oak pews with luxurious cushions invite the visitor to rest and meditation.

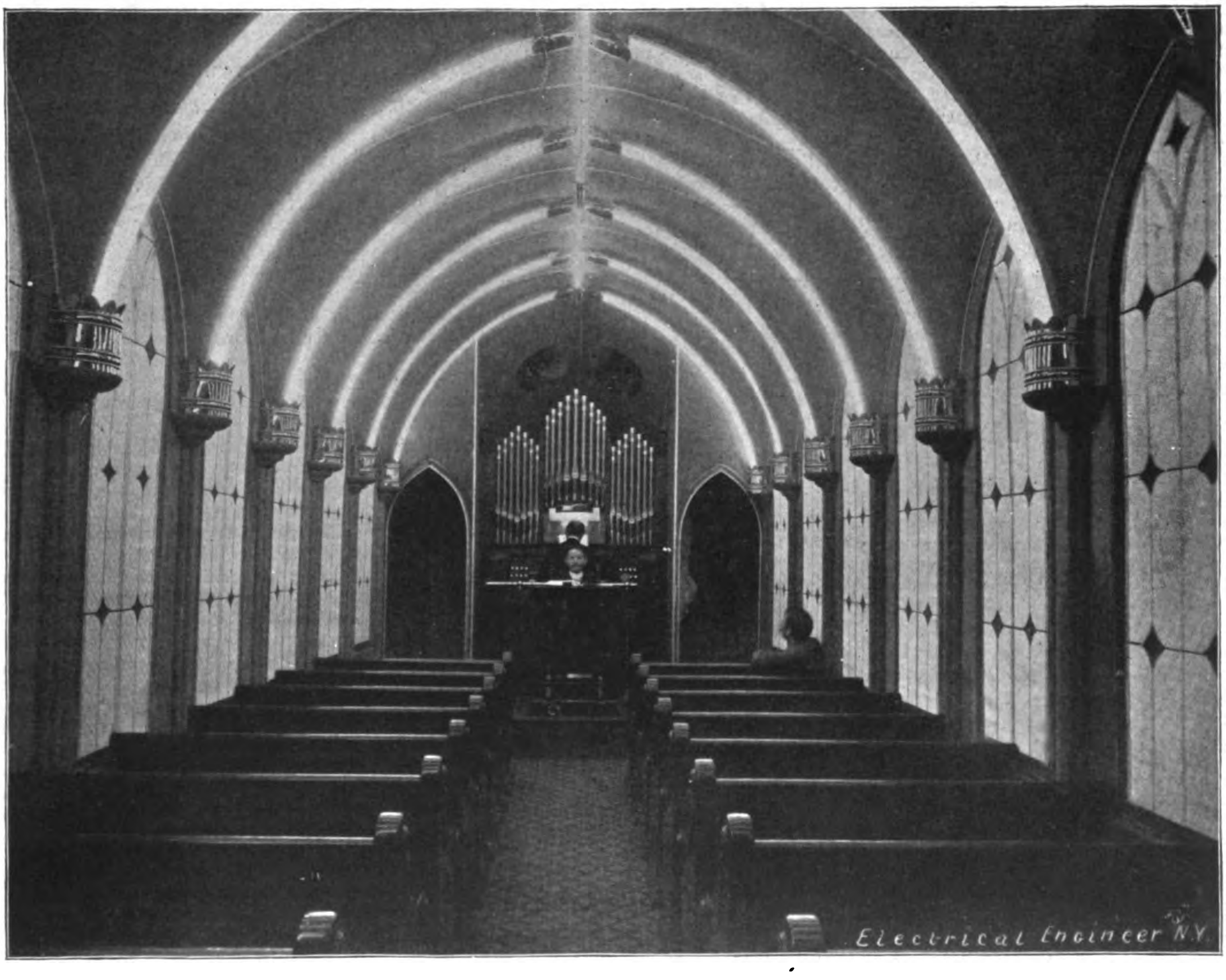


FIG. 1.—THE MOORE CHAPEL LIGHTED BY VACUUM TUBES, AT MADISON SQUARE GARDEN.
(Photographed by the light of the tubes solely.)

The predominating color of the frescoing is yellow and the imitation stained glass windows look perfectly natural.

The tube arches spring from pilasters, each capped with a highly polished, specially designed brass fixture, seen in Fig. 1. They take the form of a crown while at the apex of the chapel ceiling, where the tube arches meet, they are joined by a highly

decorated brass cylinder bent at its centre. The fixtures supporting the longitudinal tubes at the apex of the ceiling are also seen in Fig. 1.

These are the first vacuum tube lighting fixtures ever designed, and are a striking example of the manner in which Mr. Moore has worked out the one thousand and one details of his lighting system. In this connection it should be mentioned that the chapel is wired completely with iron armored conduit, again inaugurating that, which will soon become standard.

As one passes out of the exits on the sides of the organ, it is noticed that the chapel is ventilated by two 24-inch exhaust blowers over the organ pipes. A last look is attracted by the colored vacuum tube letter sign over the rear door "Let There Be Light." This is the same sign used by Governor Morton in opening the exhibition of 1896.

The church is wired with the Moore three-wire system of vacuum tube lighting; that is, all of the tubes—16 arch and 3 ridge tubes—are connected in parallel between three wires. The common or positive wire extends along the ridge, while each of the two negative wires extends horizontally along the side of the chapel back of the side fixtures, which rest on top of the pilaster caps. The three wires enter the top of a polished oak cabinet, 2 feet by 2 feet by 4 feet, which contains all of the lighting apparatus and is situated on one side of the entrance passageway as seen by Fig. 3. There also enters this cabinet at the top, the three wires connecting with the street service of the Edison Electric Illuminating Co., again fulfilling a point first called attention to by Mr. Moore, namely, that vacuum tube lighting must make its start by being adaptable to the present commercial circuits.

It will be remembered that one of the salient points in Mr. Moore's system is the breaking of the current in a vacuum. This he accomplishes by means of a beautifully constructed rotator, which is shown complete in Fig. 3. Surrounding the

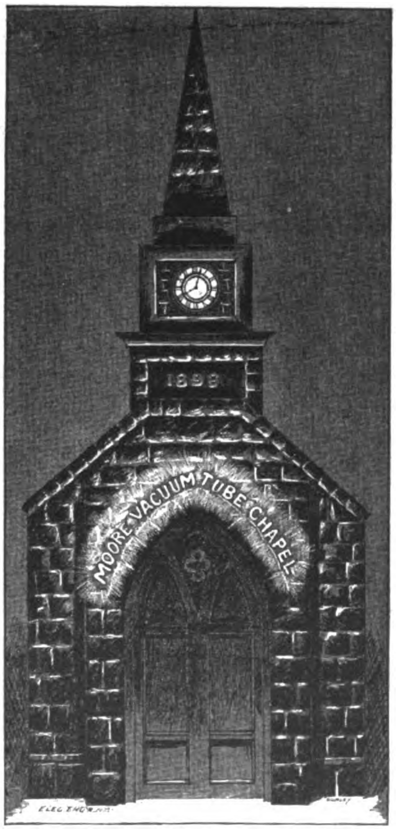


FIG. 2.—THE MOORE CHAPEL, ELEVATION.

rotator proper, which is of glass, 3 inches in diameter and a foot long, is a Gramme ring with its highly polished brass mountings, the whole constituting a beautiful piece of practical apparatus.

The apparatus just described is all that is necessary where multiphase currents are available; but in the present instance the lower comparatment of the cabinet contains a small rotary transformer.

According to Mr. Moore, the system at its present stage of development has an efficiency about equal to incandescence; but the inventor looks for still better results with improvement in the tubes—a problem he is about to take up.

Besides the rotary vacuum break Mr. Moore has gotten into

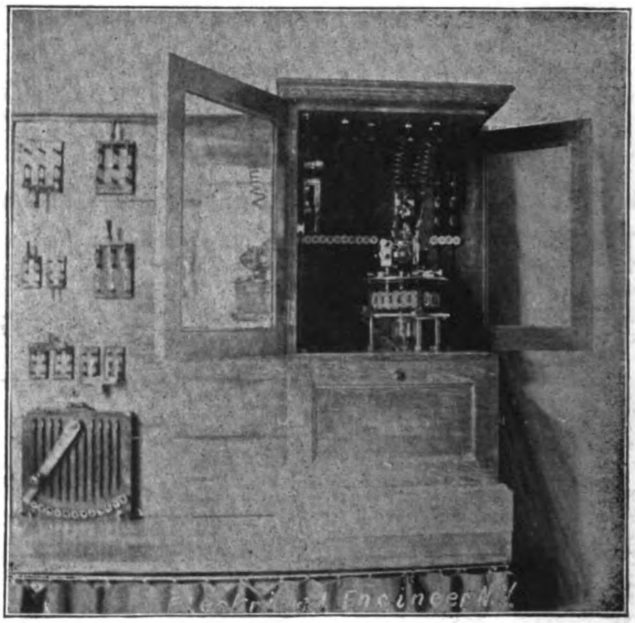


FIG. 3.—THE MOORE ROTATOR.

commercial shape a vibratory vacuum break. This apparatus will be extensively used for advertising purposes. It can be used either on direct current circuits or alternate current circuits.

There are also many other applications for this system of lighting. For example, the color of the light, even to the most delicate shades, can be changed simply by changing the degree of vacuum of the tubes, making it the ideal light for special decorative lighting. Another large field is in connection with photography—for photographers have long been longing for a light which they could regulate to a nicety and thereby obtain uniform results. At the Electrical Exhibition in 1896 Mr. Moore took instantaneous portraits by his light.

It has long been a matter of expectation as to when and by whom vacuum tube lighting apparatus would first be placed on the market, and the fact that Mr. Moore is now taking orders is extremely interesting since it is a beginning of a new departure in electrical work, which is destined, without doubt, to wide application.

In connection with the chapel exhibit, Mr. Moore has carried out a pet idea of his, which in itself is a great attraction and diversion, and in which he gives the public a chance to become personally acquainted with electricity, as it were. On a table extending along the side of the passage leading to the chapel are arranged the special attractions, every one of which is operated by the visitor closing the various switches in succession.

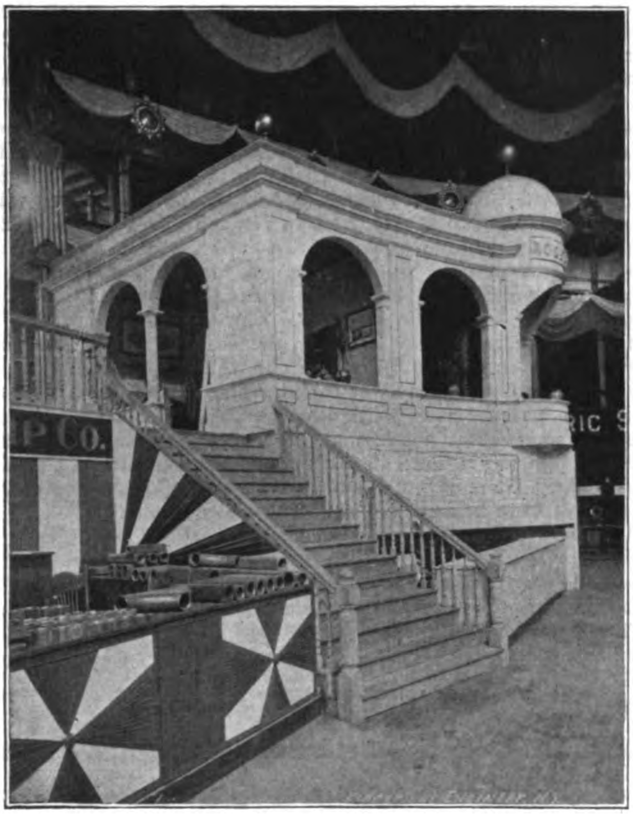
The first is a simple bell outfit consisting of battery, bell, and push button arranged so simply that everybody can understand it. Then follows an electric motor which starts so suddenly as to frighten the innocent visitor into wondering what he or she has done. Next comes a front door name-plate in vacuum tube letters; then electric fishing, a realistic bit of fun; poaching eggs by electricity; tube lighting by induction; and, finally, as the visitor is handed a pretty souvenir in the shape of a miniature vacuum tube, he receives a slight shock.

Electric Embroidery Machine.

Mr. F. Heilrath is operating the electric embroidering machine at space No. 175, main floor. The handkerchiefs embroidered with the name of the purchaser and also Old Glory are very appropriate souvenirs of the show and are in great demand.

John A. Roebling's Sons Co.'s Display.

ONE of the most tastefully arranged and most comfortably fitted out exhibits is that of the John A. Roebling's Sons Co., of Trenton, N. J. It consists of a very handsomely designed booth, arranged near the Fourth avenue entrance to the Garden, with a finely appointed reception room in the rear. The exhibit room is filled with a general line of the company's various wires and cables from the electrical department. Particular attention has been given to lead-covered cables for underground service; various types of lead encased cables with rubber, jute, and paper as the insulating material. A notable part of the exhibit is a



THE J. A. ROEBLING'S SONS EXHIBIT.

section of a three-conductor submarine armored cable, which is in all respects like one just finished at their factory—some thirty miles in length. In addition to showing these cables in original packages as sent out from the factory, they show various wires in short sections, arranged as neatly as this material can be in a place of this character. The exhibit which does credit to this very enterprising company, and is shown in the illustration, is in charge of Mr. W. S. Doyle, assisted by Messrs. M. R. Cockey, A. M. Whitaker and G. W. Swan.

Berlin Iron Bridge Company.

This company occupies a large booth seventeen feet square built of channel iron, having a gable roof. The posts and trusses are riveted and braced after the manner of the prevailing bridge and building construction followed by this company. The roof is provided with the anti-condensation roof lining which is held in place by a wire netting. Above the netting is placed a sheet of 14 pound asbestos and upon this a sheet of 6 pound asbestos and then two sheets of tar paper which is corrugated next to the iron roof. This renders it not only waterproof, but fireproof. With a bare iron roof the drip from condensation is not only annoying, but injurious to machinery and goods that may be stored on the floor; this the lining is designed to remedy.

The booth is also equipped with a specimen of the crimped iron cornice manufactured by the firm, and is decorated with a large number of framed photographs of bridges, power houses, engine houses, car sheds and other buildings which have been constructed by the company. The company is represented at the Garden by Mr. Seymour N. Robinson, the New York manager of the concern.

Niles Tool Works Co.

A large space is occupied by a fine display of the leading tools manufactured and sold by this company. The exhibit has been installed by the Eastern branch of the company, located at 136 Liberty street, New York, but the factories, which are among the largest in the world devoted to this industry, are located at Hamilton, Ohio. Special attention is given by the firm to fitting out with suitable tools, street railway and electric light repair shops, and a full line of tools has been designed and manufactured which are operated by independent electric motors, a very desirable and economic method of employing power where current is to be had. The exhibit includes planers, engine lathes, foot lathes, universal milling machines, shapers, turret headed drill presses, together with a great variety of all wrought steel, "American" patent pulleys, for which the company are selling agents.

The large planer on exhibition has a capacity for work 32 x 32 inches with a bed travel of ten feet, and is provided with two heads on the cross bar and, when required, with two side heads. The bed plates are broad and deep with double webbed housings. Power is transmitted by tangent gears running in oil, and perfectly noiseless, while the driving shaft runs in bearings composed of copper and tin, giving long life and a minimum of friction. The method of drive employed affords a steady and uniform motion of the table which reverses without shock or jar at a speed of 4 to 1, and always accurately. The patent belt shifter here employed is a peculiar feature of these planers and is so designed that only one belt is shifted at a time, which prevents any squeaking or squealing of belts, as is the case where two belts running in opposite directions are tight on the pulley at the same time. The feeds are automatic in all directions. Machines of this description are manufactured by the company with a capacity for stock up to 120 x 120 inches and with any length of bed plate.

Some of the special features of the five engine lathes on exhibition, besides being made of high grade material and superior workmanship and finish, are the deep beds, five-step cones, and graduated handles to indicate lengths of travel. The feed cones are arranged on a bracket which may be used for a belt tightener when necessary. For thread cutting it is necessary to remove only one gear in order to cut threads of any pitch. The apron is so arranged that it is impossible to throw in the rod and screw feeds at the same time. The machines on exhibition have a range of swing from 14 to 18 inches.

A model foot lathe is also shown, which is specially designed for the use of amateurs, experts, and inventors in constructing models to illustrate their various devices.

The special feature of the universal milling machines is that the table is placed on the right instead of the left side, making it easy and handy to operate.

Among the drills shown is a vertical turret headed borer with which great advantage is obtained in the quality and quantity of work. The turret head having four holes, this number of cutter-bars can be adjusted at one time, which secures absolute accuracy in work; for instance, a drill cutter-bar, counter-bore and reamer, or any other combination may be operated without resetting the work. The machines have a range of 30 inches in diameter and are designed for boring 14 inches.

A special feature of the exhibit is a great variety of the all wrought-steel pulleys for all kinds of belt transmission. These pulleys, as the name indicates, have the rim and spokes stamped from sheets of mild steel. The edges are rolled under and a web on the under side of the rim gives strength and provides a stiffener of metal and serves for the attachment of the double spoke-arms which are bolted to the peculiar shaped hub.

The special claims made for the pulleys of this type are lightness and strength, as they weigh only about one-third as much as ordinary cast-iron pulleys and about the same as wooden pulleys, while they have a high tension resistance and may be run at high speed. The smooth round finish of the edges prevents the cutting of belts and injury to the hands of the operators when it becomes necessary to shift the belts.

The hub, by means of steel bushings, is made interchangeable to fit shafts of different diameters, and can be readily removed from one shaft and adjusted to another.

Besides the tools manufactured by the Niles Tool Company

proper, the Eastern Branch handles steel hammers, electric cranes, and other large tools made by the Morgan Engineering Company, and large punches and shears manufactured by Long & Allstatter and which are designed to be driven by belts, from shafting, or by independent electric motors.

SOCIETY & CLUB NOTES

New York Electrical Society.

The 187th meeting of the society will be held in the Concert Hall, Madison Square Garden, on Thursday, 12th inst., at 8:20 p. m. There will be a short session for the transaction of current buisness, and at 8:30 Dr. Schuyler S. Wheeler will lecture on "Electrically Driven Machinery."

The lecture will be illustrated by experiments and lantern slides. The evolution of electrical machinery, as influenced by the gradual change from belt driving to electric driving will be traced, and the modifications of design making for greater simplicity thus rendered possible will be demonstrated.

Admission to the Garden can be had by the special ticket issued to the members of the society which can be obtained—price 25 cents—from the society's booth in the Exhibition any night from 8 to 9, or on application to the secretary. Ladies are admitted to the lecture, but each ticket gives admission to the building to only one person.

Meetings of the National Association of Stationary Engineers.

As previously announced, a large number of local chapters of the National Association of Stationary Engineers will hold their meetings in the Concert Hall of Madison Square during the Electrical Exhibition.

The following is a schedule of the chapters and the days on which they will hold their meetings: May 7, No. 6, New York, and Nos. 2 and 11, New Jersey; May 9, No. 33, New York; May 10, No. 29, New York; May 11, Nos. 4, 11, 13, 15 and 16, Connecticut; May 12, No. 2, New York; May 13, No. 27, New York; No. 1, Connecticut; May 14, No. 7, New York; May 16, No. 31, New York; Nos. 10 and 1, New Jersey; May 17, No. 42, New York; May 18, No. 39, New York; May 19, No. 23, New York City; May 20, Phœnix, No. 24, New York; May 21, No. 3, New Jersey; No. 8, New York; May 23, Nos. 32 and 47, New York; May 24, No. 1, New York; May 25, Nos. 55, 41, New York; May 26, No. 44, New York; May 27, No. 25, New York.

A large number of delegates are already in town, and have visited the Exhibition. They have expressed themselves as being much pleased with its practical features. Their names, destination and employment are registered on bulletin boards near the entrance to the exhibition hall and in the operative exhibit in the basement.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.—Messrs. Edison, Thomson and Sprague have accepted the invitation from the cities of Duluth and Superior and the Association to be present at the convention in June as honorary guests.

THE "GALVANOPLASTIC," a well known firm of electrotypers and stereotypers in Berlin, Germany, has recently been fitted out by F. Wesel & Company of New York City, with an up-to-date plant. Every machine run by power has its own separate Lundell electric motor, and the motors were supplied by the Sprague Electric Company of New York. It is said that this is the first and only plant of this description in the world at the present time, operated in this way, and it will no doubt attract a great deal of attention here as well as abroad.

MR. W. MAVER, JR., has removed his offices to the Beard Building, 120 Liberty street, and is a welcome addition to the large electrical and engineering colony there.

NEWS AND NOTES

The First Spaniard Captured.

MR. JOHN W. EBERT, who represents the Western Electric Company in Mexico, scored the first victory over the enemy, April 20, as shown by the following extract taken from a newspaper, "The Two Republics," published in Mexico: "Two gentlemen of this city recently paid a visit to the State of Guerrero on business connected with electric installations, Messrs. Ketchum and Ebert. On their return they stopped at Jojutla and put up at the hotel there. It happened that a Spaniard occupied one of two adjoining rooms and the landlord, wishing to oblige the two Americans, by giving them these rooms, shifted the Spaniard to a down stairs room. Messrs. Ketchum and Ebert went down to supper, and on returning to their rooms, a revolver and belt, the property of Mr. Ebert, were missing. The landlord was at once notified and on inquiry found that the haughty Spaniard had been seen sneaking down stairs, from above, where he had no business. The landlord charged him with the theft, which the Spaniard denied, and on the landlord insisting on searching his trunk and the suspect refusing to permit same, a gendarme was called. The Spaniard again made objection and the jefe politico was called in to take a hand. He very soon settled the matter by locking the Spaniard up and keeping him in jail until he chooses to open his trunk for examination. There is no doubt that he stole the articles or he would not have hesitated to open and show up at first.

So the first Spaniard has been captured by an American and held as prisoner. If every one of our boys does as well as Mr. Ebert the war will soon come to a close." Later advices direct from the seat of war state that the revolver and belt were found in the Spaniard's trunk and that he will spend six months in a Mexican prison.

Mr. C. E. Dolbear's Submarine Telegraph Tests.

The manifest necessity of establishing communication between vessels at sea and the shore in time of war has induced numerous inventors to try methods for accomplishing this end. Of the electrical methods tried, perhaps one of the oldest, but least developed is that of simple conduction, that is, taking advantage of the fact that a current flowing between two points not metallically connected spreads out in waves and covers a wide area, depending upon the conducting material, the strength of the current, and distance between the terminals. To determine the relation between these quantities and the possibility of practically employing this means of communication between our vessels now stationed in Southern waters, near the Florida and Cuban coasts, Mr. C. E. Dolbear, a son of Prof. A. E. Dolbear, of Tufts College, made arrangements with the New York "World" to carry on extensive experiments in the Kill von Kull, a channel of salt water, between the New Jersey and Staten Island shores. Fifteen hundred feet of No. 14 copper wire stretched along a rocky ledge between the railway station of Sailor's Snug Harbor and an old mill. The two ends of this wire were connected to copper plates immersed in the water and a telegraph key and a number of Mesco dry batteries were placed in the circuit. After these preliminary arrangements a party consisting of Messrs. T. A. Edison, Jr., C. E. Dolbear, W. J. Clarke, Charles Cuttriss, Chas. W. Price, Max Loewenthal, O. S. Burr, W. H. Holzer and "World" representatives, Messrs. Young and Miller, embarked on the tug "Leonard Richards" on Thursday, May 5, to conduct the experiments across the Kill von Kull, a distance of a quarter of a mile. A wire whose ends were connected to plates of copper inserted in the water over the bow and stern of the tug was cut in the middle and a telephone receiver placed in circuit. A provisional code was adopted and signals transmitted from the shore were plainly heard by those on the tug. The experiments may be considered highly successful, and may lead to gratifying and beneficial results.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued April 26, 1898.

Batteries, Secondary:—

STORAGE BATTERY. E. A. Barber, Watertown, N. Y., 603,229. Filed September 13, 1897. Comprises a series of independent superimposed oxidizable metal trays, electrolyte therein, asphalt covering for the surfaces of the trays exposed to the electrolyte, to prevent the trays from becoming gradually oxidized and destroyed, the positive and negative plates and electrical connections between each of the plates.

Conductors, Conduits and Insulators:—

ELECTRIC CABLE. N. G. Warth, Indianapolis, Ind., 603,069. Filed Oct. 25, 1897. Comprises one or more separated conductors and an impermeable and hermetically sealed conductor holder which incloses the conductors and contains compressed air or like gas confined for service as a dielectric.

LINING FOR INTERIOR CONDUITS. S. Bergmann, New York, 603,230. Filed Nov. 24, 1896. Consists in treating a tube made from an absorbent vegetable fiber in a bath of fireproof material, then treating it in a bath of drying oil, and finally drying the tube so treated.

Distribution:—

DISTRIBUTION OF ELECTRIC CURRENTS. E. Thomson, Lynn, Mass., 602,968. Filed Dec. 6, 1896. Provides means of adjustment of the primary coil of the induction coil without loss of energy to suit the potential at different points of the main line, or to suit the lamps used on the secondary local lines.

Dynamos and Motors:

ALTERNATING CURRENT INDUCTION MOTOR. C. P. Steinmetz, Schenectady, N. Y., 602,920. Filed Feb. 12, 1897. A method of compensating for the self-induction and magnetizing current of an alternating current motor, which consists in inducing from the secondary of the motor leading currents in a tertiary closed circuit in inductive relation to the secondary member.

ALTERNATING CURRENT INDUCTION MOTOR. C. P. Steinmetz, Schenectady, N. Y., 602,921. Filed Feb. 12, 1897. A method of giving starting torque to an alternating current induction motor upon a single phase circuit, which consists in producing and maintaining leading currents in a closed electric circuit in inductive relation to the primary and secondary circuits of the motor.

ELECTROSTATIC GENERATING MACHINE. A. H. Hoyt, Penacook, N. H., 603,041. Filed Aug. 9, 1897. Combines with the terminals for the working circuit spark gap arms adapted for longitudinal and rotative adjustment within their posts.

DEVICE FOR TURNING OFF COMMUTATORS OF DYNAMOS OR MOTORS. W. H. Jordan, Brooklyn, N. Y., 603,061. Filed Jan. 28, 1897. An adjustable support adapted to be clamped to the base of dynamos and motors, the support comprising a clamping plate adjustable thereon, and a standard on the last named plate, upon which the turning-off apparatus is adapted to be secured.

Electro-Metallurgy:—

PROCESS OF EXTRACTING TIN FROM TIN PLATE WASTE. J. Neumark, New York, 603,200. Filed Sept. 10, 1897. A process of regenerating an alkaline electrolyte charged with salts of tin, which consists in adding phosphoric acid to the electrolyte and, after the reaction which takes place is complete, adding calcium oxid to the electrolyte.

Electro-Therapeutics:—

ELECTRIC MASSAGE APPLIANCE. F. J. S. Lau, Kansas City, Mo., 602,950. Filed July 23, 1897. Details of construction.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. Thomson, Swampscott, Mass., 602,922. Filed Nov. 4, 1897. Combines with the feed mechanism, a thermo-electric expansive device, and a series electromagnetic controlling apparatus, responsive to variations in the current passing through the lamp governing the operation of the thermo-electric expansive device.

INCANDESCENT ELECTRIC LAMP. M. W. Dewey, Syracuse, N. Y., 603,056. Filed July 22, 1891. Comprises a light giving electric conductor, a receiver made entirely of glass and completely inclosing the conductor, and from which receiver the air is exhausted, and an electric conductor outside of the receiver and in inductive relation to the inclosed conductor.

ELECTRIC LAMP. D. Misell, New York, 603,112. Filed Oct. 9, 1897. Consists of batteries and lamp, comprising an electric headlight for bicycles.

Measurements:—

SYSTEM OF ELECTRIC METERING. H. C. Wirt, Schenectady, N. Y., 602,925. Filed Dec. 31, 1897. Combines with the circuit mains, a motor mechanism for registering the consumption of energy, and automatic means for varying the retarding effect of the meter.

HINGE CONNECTION FOR ELECTRICAL MEASURING INSTRUMENTS. A. H. Hoyt, Penacook, N. H., 603,042. Filed Nov. 1, 1897. A thermal registering maximum meter having electrical connections for the stationary and movable parts of the instrument consisting of flexible metal strips.

Miscellaneous:—

PROCESS OF PRODUCING CHEMICAL COMPOUNDS BY ELECTROLYSIS. J. W. Richards and C. W. Roepper, Bethlehem, Pa., 602,872. Filed July 6, 1897. Details of process.

PROCESS OF ELECTROLYTICALLY MANUFACTURING METALLIC SULFIDS. J. W. Richards and C. W. Roepper, Bethlehem, Pa., 602,873. Filed July 6, 1897. Consists in employing an anode containing the metal whose sulfid is desired, in a solution containing a hyposulfite salt and an electrolyte, in conjunction with any suitable cathode; passing a current of electricity therethrough, and precipitating the sulfid of the metallic base present in the anode.

ELECTRIC LUMINOUS ALPHABET AND BOARD FOR SAME. D. M. Moore, Newark, N. J., 602,953. Filed Dec. 17, 1895. An apparatus by which the letters of the alphabet, numerals, etc., may be made to appear as produced by a continuous line of light, consisting of an electric lamp fashioned to represent the desired character instead of being made up of a number of incandescent lamps.

VACUUM TUBE LANTERN. L. Wallach, New York, 602,966. Filed July 20, 1897. A device for holding vacuum tubes so as to produce a satisfactory luminous effect and at the same time present an artistic appearance.

SILICID OF IRON. G. De Chalmot, Leaksville, N. C., 602,975. Filed Sept. 6, 1895. A new product of the electric furnace being ferrosilicid containing upward of 25 per cent. of silicon, and consisting of a mixture in variable proportions of Si_2Fe_2 and Si_2Fe.

PROCESS OF PRODUCING SILICIDS OF IRON. G. De Chalmot, Holcomb's Rock, Va., 602,976. Filed Sept. 6, 1895. Similar to above.

ELECTRICAL RETORT. H. Eldridge, D. J. Clark and S. Blum, Galveston, Tex., 603,058. Filed June 28, 1897. Adapted for manufacturing hydrogen gas from water to be utilized as a fuel for heating purposes.

ELECTRICAL FOOT GEAR. J. Gallegos, Guatemala, Guatemala, 603,135. Filed March 5, 1898. Consists of an insulating insole and a generating insole laid theron, the latter being formed of a fabric composed of woven strands covered with glass beads.

ELECTRO-PNEUMATIC PIANO PLAYER. F. R. Goolman, Los Angeles, Cal., 603,184. Filed May 5, 1897. Details of construction.

ELECTRICALLY PROPELLED VEHICLE. H. G. Morris and P. G. Salom, Philadelphia, Pa., 603,198. Filed Sept. 29, 1896. A front axle having a motor mounted thereon, a forward structure forming part of the vehicle body and located directly above the front axle and carrying the battery, a rear axle, and a carriage body trailing from the front structure and mounted upon the rear axle.

ELECTRIC CLOCK. S. Fischer, New York, 603,232. Filed June 26, 1897. Details of construction.

Railways and Appliances:—

TROLLEY. J. E. Wells, Syracuse, N. Y., 602,923. Filed May 1, 1897. Designed for double track roads having a common conductor wire.

ELECTRIC RAILWAY. C. F. Holtmann and C. Bergmann, Pittsburg, Pa., 603,060. Filed Aug. 5, 1897. Sectional conduit system. Details of construction.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRICAL SELECTOR. L. W. Crowfoot and F. E. Granger, Aberdeen, S. Dak., 602,895. Filed Sept. 14, 1897. Details of construction.

RHEOSTAT. R. W. Ney, New Rochelle, N. Y., 603,027. Filed Feb. 5, 1897. Designed for use in connection with electroplating apparatus.

RHEOSTAT. H. W. Leonard, East Orange, N. J., 603,063. Filed July 28, 1896. A support covered by a layer of partially vitrified insulating material, a layer of vitreous insulating material on the layer, and a conductor held to the insulated side of the support by a layer of non-vitrified insulating material.

Classified Digest of U. S. Electrical Patents Issued May 3, 1898.

Alarms and Signals:—

AUTOMATIC ELECTRIC FIRE ALARM. W. E. Frost, Lewiston, Me., 603,270. Filed June 30, 1897. Comprises a case having an air chamber and a concave diaphragm, a circuit closing float supported loosely on the diaphragm, a guide ring of fiber secured within the case, a stationary electrode and circuit wires connected respectively for the float circuit closer and stationary electrode.

ELECTRIC SIGNAL SYSTEM. L. C. Werner, Broad Brook, Conn., 603,369. Filed June 12, 1897. A system for indicating to a moving train its position relatively to the nearest train on such track.

ELECTRIC SIGNAL SYSTEM. L. C. Werner, Broad Brook, Conn., 603,390. Filed June 17, 1897. Similar to 603,369.

Batteries, Secondary:—

PROCESS OF MAKING PEROXID OF LEAD FOR GALVANIC BATTERIES. J. D. Darling, Philadelphia, Pa., 603,361. Filed Dec. 23, 1896. Consists in compressing a mass of peroxid of lead containing free acid, and then exposing the mass to electrolytic action as a cathode in a neutral electrolyte until the superficial layer of the mass has been rendered coherent by the production of inherently formed binding material.

ART OF MAKING PLATES FOR ELECTRIC BATTERY PURPOSES. A. C. Crofton, Chicago, Ill., 603,499. Filed Feb. 5, 1897. A method of forming spongy lead plates, which consists in forcing molten lead through a series of small orifices and allowing it to pile up just before solidifying upon a horizontally vibrating surface.

Dynamos and Motors:—

ELECTRICAL APPARATUS. W. Stanley, Pittsfield, Mass., 603,515. Filed Jan. 28, 1897. An induction motor having two coils in series with each other, and with a source of alternating current, in combination with two shunts, one of less and one of greater time-constant than the coils which they respectively shunt, and a closed circuited armature in direct inductive relation to the fluxes produced by both coils.

Electro-Metallurgy:—

ELECTROPLATING APPARATUS. L. Potthoff, Flushing, N. Y., 603,286. Filed April 22, 1897. Adapted for electroplating metal.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. T. H. Pettengill, Amsterdam, N. Y., 603,283. Filed Sept. 7, 1897. A substitute for the cut-out device of Thomson-Houston arc lamps.

ELECTRIC ARC LAMP. A. W. Knutson, Galesburg, Ill., 603,383. Filed April 30, 1897. A clutch for electric arc lamps having a clutch arm formed with an obliquely disposed rod-opening piercing one side of the arm to permit of the carbon rod passing laterally into the opening, one of the inclined walls of the opening being provided with a clutch notch.

Miscellaneous:—

PROCESS OF AND APPARATUS FOR ELECTROLYTIC TANNING. E. Davis, Philadelphia, Pa., and H. R. Mustard, Smyrna, Del., 603,263. Filed July 27, 1896. Consists in vertically suspending skins in a solution of tanning liquor, simultaneously passing an electric current through the solution perpendicular in direction to the surfaces of the skins, and intercepting the particles precipitated at the anodes by the action of the screen.

ELECTRICAL ATTACHMENT FOR GAS LIGHTS. F. L. Kellner and G. S. Barrows, Philadelphia, Pa., 603,334. Filed Nov. 22, 1897. A device for operating the gas valves to turn on and off the gas and permit of its ignition by means of a pilot light. Details of construction.

ELECTRIC DENTAL ENGINE CONTROLLER. J. J. Coachman, Rio

Janeiro, Brazil, 603,524. Filed Aug. 21, 1897. Embodies a pedal mounted to swing on the base and carrying contacts, a circuit closer mounted on the pedal, and hinged wings carried by the pedal for shifting the circuit closer.

ELECTRIC CONVEYING SYSTEM. A. S. Kortz, Springfield, Ohio, 603,606. Filed Dec. 2, 1897. Adapted for store service. Details of construction.

Switches, Cut-Outs, Etc.:—

TIME LIMIT CUT-OUT. H. H. Cutler, Chicago, Ill., 603,594. Filed July 26, 1897. Comprises an active coil of a cut-out and a time limit controlling it and comprising a section of an electric circuit, the resistance of which varies with rise of temperature due to the current.

OBITUARY

Hugh E. Fitzgerald.

Hugh E. Fitzgerald, superintendent of the Detroit Electric Light and Power Company, met with a bicycle accident on April 27 that resulted in his death at Harper Hospital shortly after midnight.

Mr. Fitzgerald was riding on Grand River avenue to his home at 549 Fifth street. A car drew in ahead of him at Third street, and he veered his wheel to pass behind it. At the end of the car he was struck by another rider who was coming down Grand River avenue at a terriffic rate of speed. Mr. Fitzgerald was thrown to the pavement with terrific force, striking on his head. He lay senseless until picked up by an officer. He was carried into a drug store near by and Harper Hospital ambulance was called. At the hospital the doctors found the injured man had sustained a severe fracture at the base of the skull, and they realized that his death was but the matter of a few hours. Mr. Fitzgerald was forty years of age and had lived in Detroit about 12 years. He leaves a wife and four children between the ages of 7 and 14 years. He was a brother of W. H. Fitzgerald, manager of the Detroit Electric Light and Power Company.

PERSONAL

PROF. I. FUJIOKA, of the Imperial University, Tokyo, Japan, is on his second trip around the world gathering information on the latest electrical developments. The results of Prof. Fujioka's first trip, eleven years ago, are seen everywhere in Japan, the majority of whose electrical undertakings are due to his initiative. Prof. Fujioka intends to remain several weeks in this part of the country, with New York as his headquarters. He is to lecture before the New York Electrical Society at the Electrical Exhibition.

FREDERIC A. C. PERRINE, D.Sc., Prof. of Electrical Engineering, Leland Stanford Junior University, Palo Alto, Cal., received leave of absence for two years from active teaching. The department will remain under his charge, the teaching being done by Mr. Clement A. Copeland, an engineer of the West Side Lighting Co., of Los Angeles, a graduate of Cornell, together with Mr. F. G. Baum and G. H. Maddock, both of whom are graduates of the Leland Stanford Junior University. The company of which Dr. Perrine will be engineer is the Standard Electric Co., of California. This company will buy water power from the Blue Lakes Company, transform it into electric power and transmit from near Mokelumne Hill to San Francisco, a distance of 110 miles. There is available something like 50,000 h. p., but they will begin with a generating plant of 10,000 kilowatts. The plans are not yet formulated, and will not be before the end of the summer. The best wishes of the electrical fraternity accompany Dr. Perrine on his new undertaking.

MR. ROBERT J. PARVIN has taken charge of the New York office of "The Western Electrician," succeeding Mr. W. F. Osborne, resigned. Mr. Parvin is no stranger to the electrical field, having been for some time connected with the Chicago office of our contemporary. We welcome Mr. Parvin to his new field of activity.

REPORTS OF COMPANIES

Consolidation of Telephone Construction Companies.

Mr. J. E. Keelyn, president of the Western Telephone Construction Company, of Chicago, has just closed a deal for control of the Graham Electric Company's telephone and switchboard business as well as all of its patents. It is said this is the fifth concern that has been arranged for in like manner recently. A strong combination seems to be imminent with Mr. Keelyn as president, and a strong financial syndicate backing it.

The General Electric Report.

The weekly financial bulletin issued by J. P. Wintringham contains the following brief analysis of the General Electric Company's Annual Report, printed in our last issue:

"The report of the General Electric Company for the past year is interesting and instructive. It shows that the company earned on the common stock about $1,000,000 over the sum that would pay the preference dividend. This is about 3⅓ per cent., and would make the stock cheap at 31½. It also shows that the book value of General Electric stock is about 57, but this counts the patents at $8,000,000, and they are certainly not worth any such sum. Valueing the patents at nothing at all General Electric stock would be worth 30, and therefore it seems from every point of view, not dear at the present price of 31½."

A Thirty Mile Electric Railway.

Electrical features of unusual interest are to be associated with the new equipment of the Lewiston, Brunswick and Bath Railroad, Maine. The Westinghouse Electric & Manufacturing Company is to furnish the apparatus. Generators to supply alternating and direct currents simultaneously are to be located at Brunswick, Me., the initial installation being 1,000 h. p. Direct current is to be used at the sections of railroad in and about Brunswick, and the alternating current is stepped up to 10,000 volts and transmitted to sub-stations at Lewiston, Bath and Lisbon Falls. Here Westinghouse rotaries transform it to supply their respective trolley feeders. The A. C.-D. C. machine is a Westinghouse product, and is well adapted to work of this kind.

SAULT STE. MARIE, MICH.—The American Lake Superior Power Company is asking for bids for the construction of a water power canal at this place. The canal will be 1½ miles long, 200 feet wide and 222 feet deep. The work is one of great magnitude, involving the expenditure of several millions of dollars. A lease for a 20,000 h. p. engine, to be ready in two years, has been made to the Lake Superior Carbine works. New York and Philadelphia capitalists are pushing the work.

WOONSOCKET, R. I.—Snoqualmie Falls will supply light and turn the wheels of machinery in Tacoma and Seattle. This work is being done by Mr. W. T. Baker, president of the Chicago Board of Trade. Mr. Baker expects to expend between $300,000 and $400,000 in the development of this project.

THE FOREIGN MARKET for American electrical machinery seems to be opening up in a very satisfactory manner. The Sprague Electric Company have recently shipped several direct connected generating sets for isolated lighting plants, as well as a large number of Lundell fan motors to India and Japan.

MR. ALBERT B. HERRICK, consulting electrical engineer, has removed his offices from 150 Nassau street to 120 Liberty street, where he will be nearer his clients and have more space to accommodate an increasing business.

TRADE NOTES & NOVELTIES

The Electrical Exhibition of Philadelphia.

We are in receipt of the following communication from the management of the Philadelphia Electrical Exhibition: "From several different sources the query has come to us whether we were not a branch of the Electrical Exhibition of New York. It is impossible to find out where this rumor originated. It has no foundation whatever. The Electrical Exhibition of Philadelphia happens to follow the New York Exhibition, opening one week after the closing of theirs. The friendliest possible relations which have been in existence for many years exists between the managers of the two organizations. It is hoped that everything that is attractive to the general public shown by the New York company will find a place in the Philadelphia Exhibition. In many respects we shall differ widely from the Exhibition given in New York. We have made special arrangement for the elaborate decoration of our building by our architect, and in this point hope to surpass anything that has ever been done in the past. We have also arranged and well nigh completed an electrical cataract, which is a reproduction of one used with great success at the Opera Ball in Paris. We have secured the kinetoscope, the cinematograph, the X-ray apparatus with a screen will be constantly in operation, an electric fountain with kaleidoscopic effects produced by rapidly moving lights is now being built; arrangements are effected for the use of large quantities of decorative foliage plants in connection with electric lights. While the commercial of the Exhibition, as far as selling on the spot is concerned, will undoubtedly be a feature, we shall be very careful to limit our Exhibition to those purely electrical. We will avoid as much as possible exhibits of allied industries which might be used for other than electrical purposes. We have secured phonographic speeches from distinguished inventors and electricians and these will be given at regular intervals."

Phoenix Glass Co.

Phoenix Glass Company, 42 Murray street, New York, have on May 1 moved into larger quarters located at 15 Murray street, Franklin Building.

Harry P. Barr.

Mr. Harry P. Barr, consulting engineer, removed his offices on May 1 from 120 Liberty street to the Washington Life Insurance Company's building, 141 Broadway, corner of Liberty street and Broadway, room 1408.

Messrs. Baldwin, Davidson & Wight.

Messrs. Baldwin, Davidson & Wight announce the removal of their New York offices from the "Times" Building to 144 Broadway. Their Washington offices, as heretofore, are at 25 Grant place, Washington, D. C.

Rossiter, MacGovern & Co.

Rossiter, MacGovern & Company announce the removal on May 1 of their principal office to the new Washington Life Building, 141 Broadway. Hereafter their entire stock will be carried at their Newark factory and repair shop, 35-37 New Jersey Railroad avenue. Added facilities will enable them to display a large and very attractive stock of every kind of electrical machinery.

Pattison Bros.

Messrs. Pattison Bros. are informing their many patrons that they have removed their offices to 141 Broadway, corner Liberty street.

Westinghouse Apparatus at the Boston Terminal.

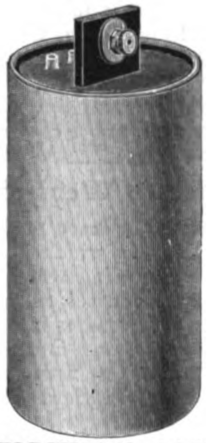
The new Southern terminal railway station at Boston is a good illustration of the scope of the Westinghouse manufactures. The switches and signal system are to be provided by the Union Switch and Signal Company; the engines by the Westinghouse Machine Company; the Westinghouse Air Brake Company will equip the rolling stock; and all the electrical apparatus will be supplied by the Westinghouse Electric and Manufacturing Company. The electric installation is to comprise 1,000 h. p. of dynamos and motors. The station when completed will be the finest in the country. Electricity will be used for lighting, for driving pumps, ventilating fans, etc.

Rapid Development of the Polyphase System.

Within the past three years the Westinghouse Electric and Manufacturing Company has installed over 100,000 h. p. of polyphase generators, ranging in size from 10 to 5,000 h. p. each. Judging from the orders at present on hand, the Westinghouse Company will build more than 100,000 h. p. of this type of generators alone during the coming year. A single order now on their books calls for 75,000 h. p. Polyphase motors have also been made in immense quantities, ranging from 1 to 500 h. p., two of the latter being for the Niagara Falls Electric Light and Power Company, where they are utilized to drive the dynamos for lighting the town, power being supplied to the motors by the 5,000 h. p. Westinghouse Niagara generators.

New Western Electric No. 6 Porous Cup Cell.

The Western Electric Company is placing upon the market a high grade porous cup, the ingredients of which are claimed to be the best that can be obtained. All material is thoroughly inspected before it is used and the recuperative powers of the cell are such that the battery will return to its normal voltage



NEW WESTERN ELECTRIC No. 6 POROUS CUP CELL.

immediately after being subjected to a severe overload. The depolarizing action, due to the pure material used is extremely rapid. All the porous cups are stamped No. 6, and any one asking for a Western Electric No. 6 porous cup will be assured of receiving an article of high grade.

Creditable Showing for Westinghouse Street Railway Apparatus.

Seventy-six double equipments of Type 49, 35 horse power motors, have been ordered from the Westinghouse Electric and Manufacturing Company by the Cleveland Electric Street Railway Co.

Mr. Chas. H. Smith, superintendent of the Lebanon & Annville (Pa.) Street Railway Co., writes: "On June 20, 1895, one of the Westinghouse 12-A 30 horse power equipments was put into service on this road. Since that time it has made 592 days, 200 miles per day, a total mileage of 118,400, without a single repair to any part of the machine, save renewal of brushes and bearings. The motors were put under a Jackson and Sharp 30-foot closed body car, running over the hardest part of the road, with less than five minutes' lay-over at either terminus, from

6 a. m. to 12 midnight. Wish all our equipments were Westinghouse 12-A."

The Chicago Fuse Wire and Mfg. Co.

This company, whose factory was totally destroyed by fire on Jan. 28, is now in better condition than ever before for filling orders for their tested fuse wire and links, which are so well and favorably known by all users of such goods.

The company calls attention to the fact that after the 1st of May all their fuse wire will be packed on the trade-mark spools which they have used for the past five years, and that these spools will in turn be inserted in neat individual tin boxes which will protect the wire from danger of abrasion and also from being affected by changes of temperature.

The company will carry a full stock of all sizes of wire, strip, links, telephone and telegraph fuses, and will make shipments from their factory in Chicago or their Eastern office at 853 Broadway, New York City, as may be most convenient to the trade. Mr. W. R. Goodman, their manager, says the great consideration shown them by all their friends in the trade during a few weeks of enforced suspension of business after the fire is highly appreciated.

Hammacher, Schlemmer & Co.

This firm, located at 209 Bowery, New York, call particular attention in this issue to their line of trimmings for phonograph and other cases and cabinets. These goods are directly in the line of cabinet hardware, in which Hammacher, Schlemmer & Co. are leaders (having been in the business for fifty years), and of which their assortment is unlimited and their stock very complete.

Besides cabinet hardware, their line of tools and factory supplies is of especial interest to manufacturers of electrical machinery, etc. In the line of piano hardware, their German steel music wire appeals directly to the electrical trade. In this wire high tensile strength and absolute uniformity of gauge and temper are pre-requisite and it is just these qualities that make the wire of value to the electrical manufacturing trade.

This firm deals direct with manufacturing consumers and issues a number of catalogues ranging in size from 25 to 400 pages, each applying to a different line of goods. These catalogues are sent gratis to responsible concerns.

Stone & Webster,

This firm announce that they have made arrangements with Prof. S. Homer Woodbridge by which his business of heating, ventilating and sanitary engineering will hereafter be intimately associated with their own electrical engineering work. They believe that there are many advantages in having all the mechanical, electrical and sanitary apparatus for a building designed and installed under the direction of one firm and the above arrangement has been made with this in view. Prof. Woodbridge has taken offices with Stone & Webster at 4 Post Office Square, Boston, and they are now ready to undertake work together.

CATALOGUES.

Electricians' Sheet Insulation Manual.

PROBABLY one of the most useful and interesting books of insulation ever gotten out is now being mailed to the electric street railways and electrical manufacturers throughout the country by the Mica Insulator Company, of New York and Chicago. The book is made up of several pages of reading matter, each one of which, aside from the title and index pages, is descriptive of the "sample of insulation" preceding the text.

The first four pages are given up in describing the company's flexible and extra flexible "Micanite" cloth and paper. The different thicknesses are given and the average break-down test runs from 296 to 439 volts per mill. These "Micanite" insulating cloths and papers are non-absorbent and remain flexible and are made with one, two, or three layers of pure India sheet Mica. The cloth averages 8, 11, and 14 mills in thickness, respectively; while the paper averages 5.8 and 11 mills in thickness, respectively. It is furnished in rolls 16 feet long and 32 inches wide.

Pages from 5 to 10, inclusive, are descriptive of "Empire" cloths and rope and bond papers. The average break-down test of these materials runs from 506 to 936 volts per mill. The cloths are made from specially prepared muslin and canvas, treated with pure linseed oil, and are furnished in sheets two yards long and one yard wide, carefully packed between sheets of plain paper. The papers are made from the finest grades of rope and bond paper, treated with pure linseed oil, and are furnished in sheets 19 x 24 inches, 22 x 34 inches, and 36 x 72 inches. They are 4½ and 5 mills in thickness.

Pages from 11 to 14, inclusive, are descriptive of the new insulations which the company are placing upon the market, viz., "M. I. C. Compound," insulating cloths and papers. The No. 1 cloth is made from specially prepared muslin and treated with two baked coatings of M. I. C. Compound, while the No. 3 is made from the best canvas and treated with three coats of M. I. C. Compound. Each is furnished in sheets two yards long, one yard wide, and carefully packed between sheets of plain paper, the average break-down tests being 654 and 650 volts per mill, respectively. The No. 1 cloth is seven mills in thickness, while the No. 3, which is used for heavy armature work, is 15 mills in thickness. And the M. I. C. Compound rope and bond papers are made from the finest grades of material and treated with two baked coatings of the M. I. C. Compound, furnished in sheets 19 x 24 inches, 22 x 34 inches, and 36 x 72 inches, with average break-down tests of 739 and 859 volts per mill, respectively. Thickness, 4½ and 5 mills.

The flexible "Micanite" plate, Style B, which the company have sold so largely, is described on page 15, and is furnished in sheets 36 x 36 inches, in any thickness from 10 mills up. This material is used for insulating armature slots, armature, magnet, and commutator cores, transformers, etc.

Another new product of the company's is the oiled Asbestos paper, described on page 16, which is made in sheets two yards long and one yard wide. Standard thickness, nine mills; break-down test, 320 volts per mill. This material is usually used in conjunction with the "Empire" cloths. The two combined make a strong semi-fireproof insulation of a very high resistance.

Page 17 is descriptive of the Standard "Micanite" plate No. 1, which is suitable for general purposes. This plate is suitable for commutator rings, armature slots, spools, transformer insulators, etc., and is furnished in plates of any thickness and of any size up to 40 inches square. The average break-down test is 1,012 volts per mill of thickness, the standard size being 18 x 36 inches. The standard sizes are carried in stock ready for prompt delivery.

The "Micanite" plate, which is especially for commutator segments, is described on page 18, and is called No. 2 Special. It is from this plate that the company saw their segments which have achieved so great a success among builders of electrical machinery and railways during the last two or three years. The plates are furnished in any thickness, size 18 x 36 inches, and gauged to a thousandth of an inch. The company claim advantages for this material over the use of India mica, on account of the treatment which the mica has, so as to wear away equally with the copper.

The other part of this handy book is given over to the description of the company's M. I. C. Compound, which is being used so largely throughout the United States. Two important testimonials appear as a finale to this work, which came from two leading builders of electrical apparatus.

The company will be pleased to mail upon application to those who are users of high grade insulators a copy of this manual or book on insulation, and also call attention to the fact that their materials are carried in stock both at New York and Chicago.

The Lunkenheimer Company.

A very complete and handsome catalogue and price list has recently been issued by the Lunkenheimer Company, of Cincinnati, Ohio. This company manufactures the well known Lunkenheimer valve, injectors, whistles, lubricators, oil and grease cups and steam specialties. A number of pages are devoted to illustrations of the numerous medals and awards taken by the Lunkenheimer productions. The catalogue contains 200 pages, embodying a large number of valuable tables and other useful data.

The American Electrical Directory and Buyers Manual.

The first number of the sixth volume of the American Electrical Directory and Buyers' Manual has been received, and does not lack in completeness and usefulness of reliable data. The edition contains alphabetical indexes to advertisers and buyers' finding list, editorial comments, electric light associations, electric light central stations, general information, and a moonlight schedule.

Lundbergs' Electric Light Fittings.

A very attractive and useful catalogue and price list has recently been issued by A. P. Lundberg, Bradbury Electric Works, Kingsland, London, N. The catalogue contains a variety of electrical apparatus, such as switches, wall connections, lamp sockets, cutouts, switchboards, etc. It has a handsome white cover, with a very artistic design in gold and color.

Central Electric Company's Iron-Clad Fan Motors.

A very unique announcement has just been issued by the Central Electric Company, Chicago, Ill. It consists of a folded postal card bearing on one side the address, and an announcement of Okonite products, and on the other side the significant inscription, "A dollar an inch for fan motors put up," meaning that the price of a 12-inch fan is $12, a 16-inch fan $16, etc. On the inside pages are a number of fan motor cuts, and the company's sound advice to their patrons that they can do twice as much work, with four times the comfort and can get two night's sleep in one if they have one of these busy, breezy motors, distributing refrigerated imitations of lake breezes.

The Falls Rivet and Machinery Co.

The Falls Rivet and Machinery Co., of Cuyahoga Falls, Ohio, are distributing a circular illustrating and describing their power transmitting machinery such as shafting, pulleys, couplings, pillow blocks, rigid boxes, friction clutch pulleys and couplings, rope sheaves, floor stands, etc. The circular contains numerous illustrations of these appliances.

WESTERN NOTES

THE managers of the Alley L Road of Chicago, which is now installing the Sprague multiple-unit system, report that as soon as the steam trains are off the line they will be able to reduce their schedule from thirty-eight to thirty minutes, and that they will save in transportation wages alone more than the total depreciation, and will make the old steam service mileage with 15 per cent. fewer cars. They also report that the strains on their structure are noticeably reduced, and that the increase in their traffic has already added quite a percentage to their receipts.

THE WESTINGHOUSE ELECTRIC AND MFG. CO. has sold to the Citizens' Street Railway Company of Indianapolis, a 500 kilowatt, 90 r. p. m. machine of the Westinghouse standard type. The machine is direct connected to an Allis-Corliss engine. It is over compounded 10 per cent., the normal potential being 550 volts.

THE ELECTRICAL EXCHANGE report great success with their new agency of the Midget Upton arc lamp. They have already secured orders for a large number from all parts of the country. One shipment was sent to St. Michaels, Alaska. In addition to the regular line of Midget Upton lamps, the Exchange is putting out a new Midget Upton alternating lamp which is meeting with great success. The Exchange carries a full line of Midget Upton lamps in Chicago stock, and would be pleased to have prospective purchasers call and examine the various samples now on exhibition.

THE CHICAGO EDISON COMPANY'S second-hand department is selling only its own stock, which is drawn from its numerous customers on its Chicago circuits. It has its own repair shop, and all second-hand apparatus is put in the best possible condition before delivery.

THE CENTRAL TELEPHONE ELECTRIC CO., 1123 street, St. Louis, Mo., report that business has been very brisk with them, having installed several large exchanges, and they have created a large demand for their telephone transmitters, as they are now making a specialty of furnishing these goods to telephone exchanges.

THE PAXTON HOTEL, OF OMAHA, NEB., will have an electric light plant; a "Ball" engine, built by the Ball Engine Company, Erie, Pa., supplying the power.

THE GROWING DEMAND for sulphuric acid for storage batteries is being largely supplied by The Grasselli Chemical Company, of Cleveland. They are providing an acid which is especially adapted to battery use. Their facilities for reaching the trade are of the best, owing to their having several manufacturing plants, the principal ones being at New York, Cleveland and Chicago; the main office being located at Cleveland.

THE CENTRAL ELECTRIC COMPANY, of Chicago, are carrying in stock all sizes of double and single, silk and cotton covered magnet wire, up to and including No. 40, and are prepared to meet all orders for these goods.

THE CENTRAL ELECTRIC COMPANY, of Chicago, are introducing a new and very ingenious device for ceiling clusters, consisting of a porcelain block with a metal canopy, which attaches directly to the ceiling and having the sockets embodied as a component part of the fixture. They are furnished in various sizes from two to five lights and are specially designed for street car work. Special circulars relating to this device can be sent on application.

NEW YORK NOTES.

THE SPRAGUE ELECTRIC COMPANY have just received a contract for seven worm-gear drum elevator machines for the Government Printing Office at Washington, D. C. A significant fact is that one machine of this type was ordered two years ago, and the satisfactory service that it gave led to the second order noted above.

THE MAGNOLIA METAL CO. inform us that they have secured a perpetual injunction and been awarded damages against the Nassau Smelting and Refining Company for infringement of their trade-mark "Magnolia." Judge Wallace rules that the assumption of the trade-mark "Mongolia" by the defendants was calculated to deceive the public, and restrains its further use.

THE ELECTRIC ARC LIGHT COMPANY announce the removal of their New York office to 120 Liberty street, the home of the "Pioneer" enclosed arc.

MR. F. H. SCHLESINGER, 220 Broadway, New York, representing the Peru Electric Mfg. Co., of Peru, Indiana, informs us that his trade in China insulation, also batteries, for many months past has been very satisfactory and their factory running steady on orders.

SCHMIDT & BRUECKNER, 289 Greenwich street, New York City, will soon put on the market an improved arc lamp of the enclosed type, which for simplicity of mechanism is unequaled, it is claimed. It is likely to make a sensation. The firm report that their telephone business has increased so rapidly as to necessitate the devotion to it of further floor space in their factory.

NEW ENGLAND NOTES

THE WHITIN MACHINE COMPANY, of Whitinsville, Mass., have just completed a new casting shop which will be entirely fireproof. It is furnished by The Berlin Iron Bridge Company, of East Berlin, Conn.

A DIRECT CONNECTED ELECTRIC LIGHT PLANT is being placed in the Exchange Building, Boston, Mass. The engine is supplied by the Ball Engine Company, Erie, Pa., and the dynamo by the Westinghouse Electric and Manufacturing Company, Pittsburg.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have just completed for the Conway Electric Street Railway Company, at Conway, Mass., a steel bridge to carry their electric line across the Deerfield River. This bridge is about 300 feet in length.

ADVERTISERS' HINTS

UEHLING, STEINBART & CO. have removed to 42 Fourth street, Carlstadt, N. J., where they are better prepared to fill their orders for the instruments which have made this firm so well known.

MATHIAS KLEIN & SON advertise tree climbers.

THE C & C ELECTRIC CO., 143 Liberty street, New York, repeat their invitation to inspect their exhibit at the Electrical Show.

THE GOODYEAR VULCANITE CO., 568 Broadway, New York, manufacturers of hard rubber goods of every description, wish it understood that they are not connected with any other firm.

THE SPRAGUE ELECTRIC CO., New York, offer Lundell 12-inch desk fans for all voltages up to and including 230 volts.

I. P. FRINK, 551 Pearl street, New York, are selling a Parisian novelty consisting of silk and velvet shades of fleur de lis pattern for incandescent lamps. They have them in a variety of colors.

R. THOMAS & SONS CO., East Liverpool, Ohio, call attention to the 60,000 volt tests made on the Boch glaze filled high potential insulators at their booth at the Electrical Show.

THE NEWTON APPLIANCE CO., 120 Liberty street, New York, have a complete line of push button flush switches. They also have wood mats to install them with in different colored woods.

WM. ROCHE, 259 Greenwich street, New York, say there is no cut in the prices of the "New Standard" dry batteries.

CASS & AARON, 141 So. Clinton street, Chicago, repair all kinds of electrical machinery and apparatus and offer some bargains in motors, dynamos, meters, etc., all ready for immediate delivery.

THE POPE MFG. CO., Hartford, Conn., are building all styles of electric carriages.

DESK AND CEILING FANS for alternating current are advertised by the Emerson Electric Mfg. Co., St. Louis, Mo.

THE PHOENIX GLASS CO. have removed to 15 Murray street, New York, where they are carrying a full line of shades for every conceivable kind of lamp.

THE WARD-LEONARD ELECTRIC CO., Bronxville, N. Y., are working day and night to keep up with the orders for their circuit breakers and rheostats. The reason for it is the prices at which they are selling them, some of which are quoted in their "ad" this week.

THE WESTERN TELEPHONE CONSTRUCTION CO., Chicago, Ill., state that they are in every way in a better condition than ever before. They also have a word to say about their recent court decisions.

THE DEARBORN DRUG AND CHEMICAL WORKS, Chicago, Ill., who make it a specialty to prescribe a boiler compound to suit each case say: "There are four of our chemists and some forty of our salesmen who draw twice the salary and forget more in ten minutes on this subject than three-fourths of the cheap operators of the electrical plants who are so wise and afraid to spend a few dollars for a reliable preparation."

THE INSULATING SADDLE STAPLE CO., Brockton, Mass., are manufacturing a staple for use in all kinds of interior wiring, a feature of which is a lining of fibre on the inner side of the arch.

H. B. COHO & CO. are now located at their new quarters at 30 Cortlandt street, New York.

THE ELECTRICAL EXCHANGE, 166-174 South Clinton street, Chicago, publish a revised list of apparatus which they offer at bargain prices. They will send their bulletin on application.

THE WESTINGHOUSE MACHINE CO., Pittsburg, Pa., say that their Westinghouse compound made the world's record for economic duty of non-condensing engines and that it has never been beaten.

THE HIGH TENSION STORAGE CO., 1215 Filbert street, Philadelphia, Pa., illustrate some of the applications of their batteries.

THE WAGNER ELECTRIC MFG. CO., St. Louis, Mo., call attention to the deadbeat action of the Wagner voltmeter.

HUNTER FAN AND MOTOR CO., Fulton, N. Y., mention the details of the 1898 Tuerk ceiling fans—alternating or direct current.

THE MONARCH MFG. CO., 39 Cortlandt street, New York, announce that by simply pressing a button an engine may be stopped, any valve in the steam pipe may be closed, or anything may be stopped controlled by valve or lever. Of course this is accomplished by the "Monarch" speed limit.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. MAY 19, 1898. No. 524.

MISCELLANEOUS

The Andreoli Commercial Ozonisers.

M. EMILE ANDREOLI, of London, whose work in the domain of ozone generating apparatus has already been mentioned in The Engineer, has devised two new kinds of ozonisers. The first is a medical and sanitary apparatus in the form of a vacuum tube, containing a metallic rod and surrounded by an aluminum armature. When the current from a Ruhmkorff coil or from a 3,000-5,000 volts transformer is sent through it,

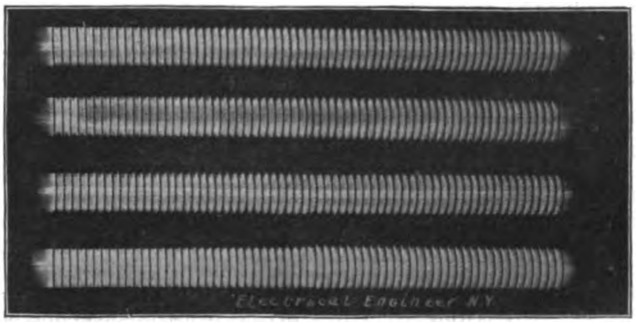


FIG. 1.—LUMINOUS TUBES PHOTOGRAPHED IN DARK ROOM WHILE WORKING.

the tube becomes luminous and ozone is generated round it. These small ozonisers for domestic purposes are most compact, elegant and efficient for sanitary, disinfecting and medical purposes.

Fig. 1 shows four ozonising tubes, taken in a dark room; this set of open ozonisers is actuated by the current from a transformer which raises the current supplied from the street mains from 100 volts to 4,000 volts.

Eminent physicians, well known in England and abroad, have prescribed ozone in many cases. Ozonised oxygen insufflated on wounds produces a remarkably beneficial action. Ulcers which had resisted every other treatment began to heal at once, and the wounds rapidly filling with healthy tissues. In rooms it purifies the air. Many consumptives have been cured by in-

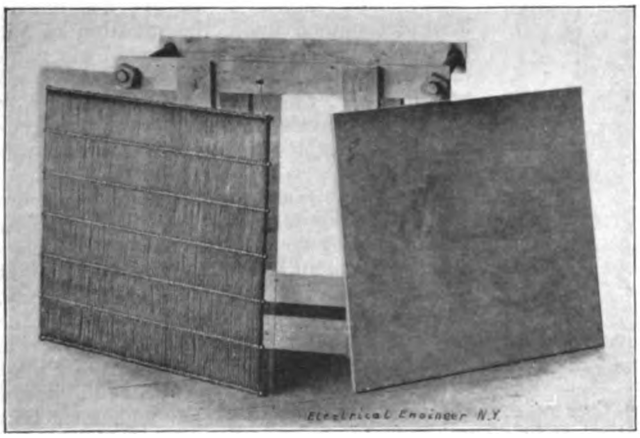


FIG. 2.—FRAME WITH SHEET OF DIELECTRIC AND FLAT ELECTRODE, 2 x 2 FEET.

halation of ozonised oxygen. The essential point is not to administer ozone in extremis. Some examples of the efficacy of these ozone inhalers are reported in the "Lancet" of the 9th of May, 1896, and the "British Medical Journal" of the 10th of October, 1896, where two physicians tell how they treated patients with complete success, in cases of anaemia and other diseases, simply by employment of the ozone of these luminous tubes.

In his "Researches on Tuberculosis," which won the Weber-Parkes Prize Essay in 1897, Dr. Arthur Ransome, M.D., F.R.S., speaks of the treatment by means of ozone and says that with the ozonisers here described great benefit was generally derived by the patients, and although gratifying results had often been obtained from other treatment, he did not remember any that were quite so satisfactory as in those cases in which the ozone was also used.

The second kind of ozoniser devised by Mr. Andreoli is extremely interesting from an industrial point of view. It consists of grids formed of aluminum serrated wires and of flat aluminum electrodes (Fig. 2). These are kept separated by sheets of glass and the whole of the plates and grids are held together by means of wooden clamps. Their construction is extremely simple. No skilled labor is required either to make an installation or to

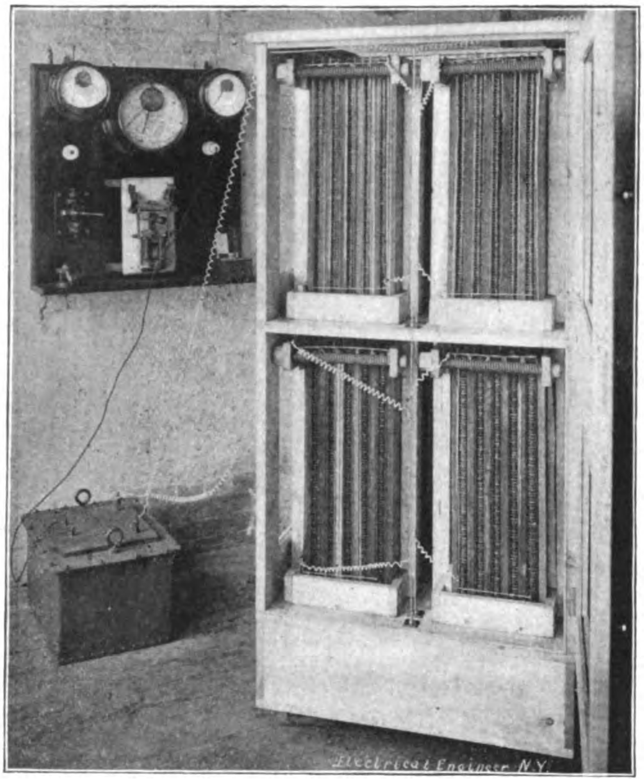


FIG. 3.—EIGHT SETS OF ELECTRODES IN CASE MOUNTED IN PARALLEL.

superintend it. There cannot be any uncertainty or disappointment about the regular working of an installation, however large it may be, since if a given quantity of ozone is produced by a given surface of electrodes of an ozoniser with a given expenditure of electrical energy per hour, we know accurately how many similar ozonisers will be required to obtain a desired quantity of ozone in any time.

These commercial ozonisers produce about 125 grammes of ozone per kilowatt, and are the best for industrial applications. They can be adapted to large installations, and supply ozone at something like $1 per 11 pounds.

The special features of this ozoniser are that the yield of ozone is increased very considerably. There is no circulation of water for cooling purposes. The generation of excessive heat by the electric action on the dielectrics and electrodes is avoided. The electrodes of this form of ozoniser are point-bearing grids facing flat electrodes. The point-bearing grids are composed of a number of serrated wires mounted on rods running through them and kept separated by washers.

Fig. 2 shows one of the grids. There are 80 rows of serrated

wires each having 222 points, making a total of 17,760 on both sides. This shows how, with a moderately high frequency and a low tension, it is possible to obtain a feebly luminous glow and discharge sufficient to bring about the formation of ozone without the production of nitrous compounds or rise of temperature which would affect the yield of ozone. The flat electrodes are made of boards of wood, which are plane and true, and on the two sides of which are fixed thin sheets of aluminum. In this way perfectly even and plane plates at a moderate cost are obtained. Instead of metal sheets, layers of metal can be obtained by electro-plating. An insulating material such as glass is used to separate the electrodes.

Fig. 2 represents one of the grids with a glass sheet behind it, which serves to separate the grid from the flat electrode. It

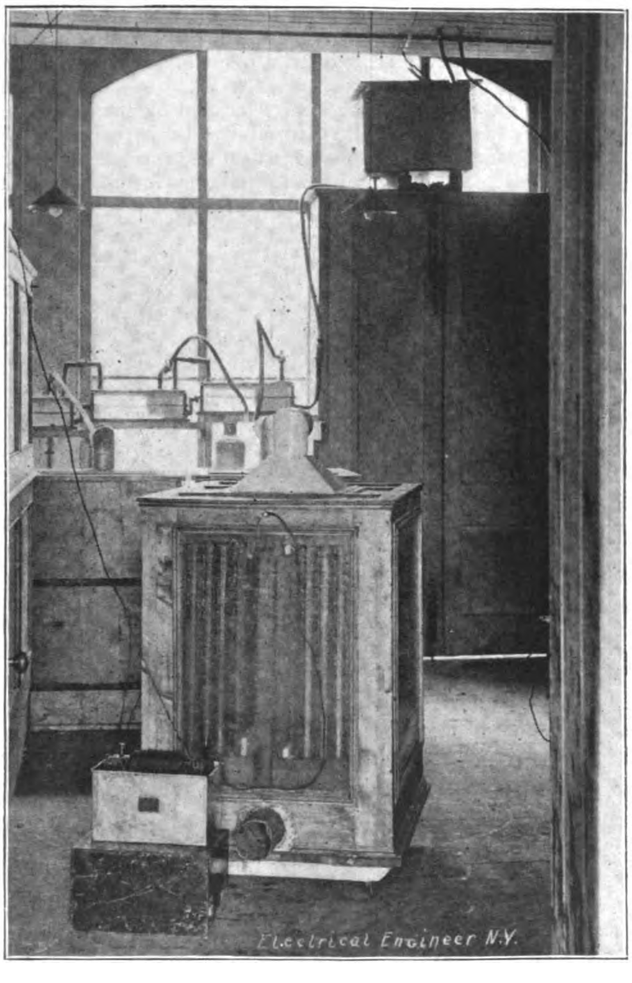


FIG. 4.—OZONIZER, 160 SQ. FT. OF SURFACE, WITH TANKS FOR STERILIZING WATER.

is placed against a wooden frame, which is coated with some insulating material, and which serves to keep the dielectric plates and electrodes together. Next to this is a flat electrode 2 x 2 feet.

Fig. 3 shows an installation consisting of eight sets of electrodes in a case, mounted in parallel with switchboard and Crompton transformer. Fig. 4 shows a type of ozone generator with 160 square feet of surface; in the background are shown a series of tanks for sterilization of water experiments.

The uses to which ozone can be applied are almost without limit. We need only mention a few, among them: Bleaching; ageing of wines and liquors, purification of oils of all kinds, vinegar making, seasoning wood, sterilization of water, etc.

The ozonisers described above are now regularly built by the Electric Ozone Syndicate, Ltd., under the Andreoli patents.

MR. G. ROLF, one of the departmental managers of the firm of Scott & Mountain, of Newcastle-on-Tyne, England, who built the pumping plant for the large floating dock at Havana, is on his way home via New York. Mr. Rolf is making a tour of inspection of the latest American lighting and power stations in this section.

Electricity in the Mackay Mausoleum in Greenwood Cemetery.

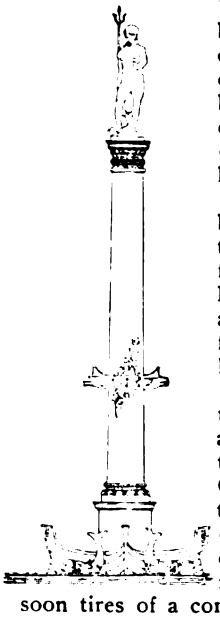
One is hardly accustomed to look for cheerfulness in connection with anything associated with the dead, but that electricity can be made to go a great way towards making the tomb a place of rest and comfort to the mourner in all weathers and at all seasons of the year is fully demonstrated by the unique installation recently completed in the Mackay mausoleum in Greenwood Cemetery, Brooklyn, N. Y.

The interior of this beautiful structure is lighted by sixty 10 candle power incandescent lights placed at the base of the dome roof, and hidden from view by a heavy marble cornice. The lamps are set in a horizontal position, and below them is a special, white enameled copper reflector fitted to the base of the dome in such manner that the light is reflected to the dome which is decorated with Venetian mosaic work. In this manner the whole of the interior of the mausoleum is thoroughly lighted without any shadows, there being a perfect diffusion of light, and a very pleasing effect.

The heating and ventilation is accomplished by a series of heater plates taking a current of eighty amperes at 220 volts, installed in four series of 20 amperes each, so that any desired temperature can be obtained according to the requirements of the weather. There is in connection with this electric heater a nine-inch air duct leading in from the outside of the vault; through this is drawn in a current of fresh air which in passing over the heated plates gives a constant supply of pure warm air to the interior of the mausoleum. The foul air passes out at the top of the dome, thereby completing the system of perfect ventilation for the interior. The heating apparatus is sunk in the centre of the mosaic floor and covered by a handsome bronze grill work flush with the floor.

The lighting and heating is controlled at the panel and distributing board set flush in one of the black Belgian marble panels inside the mausoleum, which is enclosed in a handsome bronze frame and marble door. The whole of the electric work was designed and installed by Messrs. Zimdars & Hunt, of New York. The current is furnished by the Brooklyn Edison Co., from circuits fed from their new Bay Ridge Union Station.

The Electric Fountain "Nautilus" at the Transmississippi Exhibition, Omaha.



T may be taken for granted that no exhibition of moment is now projected without embodying in its plan a fountain of one description or another. The Omaha Exhibition is no exception to this rule; on the contrary, a water scene including a fountain display may be said to be the most prominent landscape feature of the entire Exhibition.

The main features of the grounds having been determined upon, the question of the type of water display to be adopted was carefully considered, and the result is the "Nautilus" fountain, which in beauty of conception and in size rivals anything which has thus far been attempted in electrical work of this kind.

The Omaha fountain is distinguished from that which was installed at the World's Fair at Chicago, by the fact that, whereas the latter was a luminous fountain, the one at Omaha is electrically lighted; that is to say, there are no submerged lights. While the electrical self-luminous fountain is one of display and effect and in the nature of a play, it must be operated at intervals, as the public soon tires of a continuous gaze at one object, no matter how beautiful or brilliant it may be.

An electrically lighted fountain, on the other hand, such as that at Omaha, is more on the order of a natural display and in this case serves the double purpose of a further embellishment to the grounds and may be kept in play at all times both day and night, without in the least causing the observer to tire; indeed, it will prove restful to the sightseer.

The general plan of the arrangement of the fountain is shown in the accompanying illustrations. The fountain is the principal

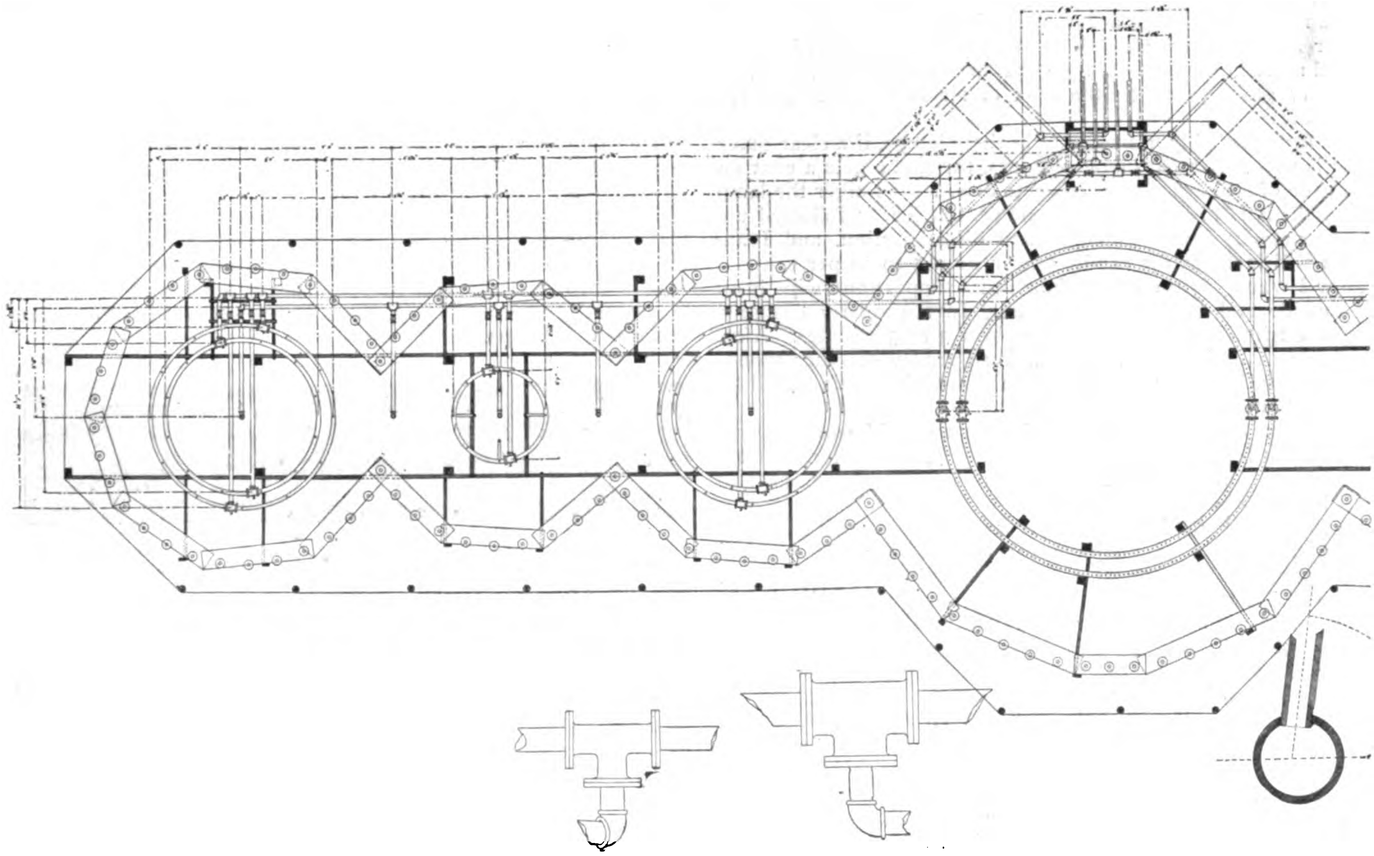
feature of the lagoon, which is half a mile long and about 400 feet wide, and around which the principal buildings of the exhibition are grouped. One end of the lagoon on which the United States Government building borders opens out in the shape of a clover leaf at one end of the Grand Court, and in the centre of this clover leaf stands a beautiful, classical shaft surmounted by a figure of Neptune, shown at the head of this article.

For a distance of 60 and 70 feet on either side of this column hundreds of jets, slightly protruding from the surface of the water, eject their streams in fanciful forms and figures in harmony with the surroundings. Where the spray and jets strike the water a border of incandescent lamps in various colors, and embodied in the form of lilies, seemingly float on the water. Immediately surrounding the column at its base are two concentric circles, the outwardly directed jets of which form a hedge-like enclosure, symbolic of Neptune's captivity. On either side of these rings are two additional rings, one of parabolic jets, and one with a central geyser; beyond that are a series of ring jets and a setting of pyramid jets, and centrally a large geyser. At the two extremes there is a similar arrangement which flanks the main column on either side.

The fountain proper forms a series of slightly intersecting circles, and following the curves of these circles is a continuous border of incandescent fancies in the form of floating water lilies. The fountain proper will be flooded with light from points of vantage by means of searchlights and so arranged that the source will never be in the line of sight of the spectators.

The supply of water is derived from the city water works, the water being led out into the lake from the Government Buildings, where the water controlling valves are installed. After expending its pressure for the fountain the water serves to replenish the evaporation of the lake. The entire piping jets and frame work are supported on piling sufficiently submerged to conceal all evidence of construction; only the protruding nozzles or jets disclose the presence of a fountain when in operation.

The fountain is original in its conception, and adapted specially to the favorable conditions that the site affords. It is from the designs of Mr. Luther Stieringer, consulting engineer. The working details and the entire construction were carried out by Mr. Henry Rustin, electrical engineer, with the assistance of the Exhibition staff, and the results attained will be largely due to the fidelity and interest shown by the latter in carrying out the plans.



PLAN OF ELECTRIC FOUNTAIN "NAUTILUS," AT OMAHA, SHOWING ARRANGEMENT OF PIPES AND VALVES.

ELECTRIC LIGHTING

Trimming and Cleaning of Enclosed Arc Lamps.

BY J. H. HALLBERG, E.E.

THE trimming and cleaning of the inner globes of enclosed arc lamps is of the utmost importance, as the efficiency or candle power depends, to a large extent, on the transparency of the inner globes. It is a very serious matter and well worthy of careful consideration. My object is to suggest to the reader a system for doing this work, which will save many inner globe "kicks" from customers, and save carbons and labor; it may be applied to any size plant.

The following suggestions are based on the claims that one 12x½ inch solid carbon will burn 125 to 150 hours, and apply to all enclosed arcs except the alternating, in which are used various sizes of carbons, some lamps using one solid and one cored, others two cored carbons, and there may be alternating current lamps that use solid carbons in both top and bottom, but as yet are not advertised in this country.

Let us suppose I am manager of a lighting plant, and a number of enclosed arcs have been put in service for either commercial or street lighting, and it was required to get up a system of trimming and cleaning of these lamps; I would proceed as follows:

I would first make a box of tin or zinc about 18 inches long by 13 inches wide by 6 inches high, and space it off so as to get room for 13 inner globes, 25 or more upper carbons, 25 or more lower carbons, 25 stubs of carbons left in upper holder after 125 to 150 hours' run, 25 stubs of burned-out lower carbons, and one space for a few small repairs, tools and rags for wiping.

I would cover the inside (bottom) with 1-16-inch thick asbestos, which will prevent the chipping or breaking of the inner globes when they are placed in their spaces. I would attach a

strong strap to this case for carrying same and get an oil-cloth, or similar goods, to cover the globes and carbons in rainy weather, as dampness on carbons and inner globes has a bad effect on enclosed arc lamps. Then I would buy one extra inner globe for each lamp, as many carbons as I would need for one year, and a few screws, etc., that are liable to get lost or damaged during burning or trimming.

When time comes for retrimming of lamps, I would place 12 clean inner globes in their respective spaces in the box, leaving the 13th space empty; 25 upper carbons, 25 lower carbons in their spaces, and a few of the small screws, etc., with tools or rags in their space; now all spaces but three in the box are filled. I put on a pair of gloves, pick up my box and ladder, and start to trim, as follows:

First shut off current if lamp is burning or not, lower outer globe, take out dirty inner globe, place same in the 13th space in box, remove carbons left in upper and lower holder, and place them in their respective spaces; place new upper carbon in its holder (firmly) and try it up and down slowly to insure against binding; place new lower carbon in its holder, being sure no broken piece is left in bottom and that carbon is down as far as it should go; put on clean inner globe and lift clutch up so as to see that everything works right.

Take a rag and wipe any part of lamp that may be dusty or dirty and reach down and wipe out the outer globe, as there is always more or less dust accumulated in it, either from the outside or from the arc enclosed in the inner globe; this latter is noticed more in the type of lamps that are designed to depend on the outer globe to check the inlet of air in order to get 150 hours' life.

You have probably noticed that in these lamps, if a clear outer globe is used, after 100 or more hours, the globe gets a coat on the inside of a bluish film which gets denser the longer the lamp burns. This is probably a small thing, but if it is followed up, it may prevent some "kicking" and dissatisfaction, and I am sure it will increase the candle power from 5 to 10 per cent.

Now I would set the outer globe in its support and wipe it on the outside and turn on the switch. In a properly designed lamp the trimming should not take over 3 to 5 minutes. After trimming 12 lamps I would get a fresh supply of inner globes and carbons, leaving the old ones in the station; this would be continued until all lamps were trimmed.

Now I have a system of trimming that should work to perfection with few minor changes to suit local conditions; and I also have a number of burned top and bottom carbons and dirty inner globes.

I will first rig up for cutting the carbon pieces left in upper holders for use in next trim lower holder. I would make a simple gauge of some metal, the exact length marked on tag of lamp, and cut my carbons with a hack-saw or a pair of shears, which I prefer, to this gauge, always taking care to get the size within 1-16 inch; this is of much importance. Next, I throw away what is left of the lower carbons, as they are worthless.

My next move will be to clean the dirty inner globes. In looking them over I will find most of them are covered with a grayish-white dust or film on the inside, which comes off if the globe is washed in clean water; but I will also find some that after they are washed in water, show a brownish-black stain around the top of the globe which apparently will not come off, no matter how much it is washed; in fact, it seems as if it was a natural color in the glass itself.

This is not the case, it is caused by several things; the most common cause is impure carbons, which contain too many metallic substances; by the lower carbon being too long, which in turn brings the arc too near the neck of inner globe; or it may be caused by too much current flowing across the arc, especially during the few minutes after trimming lamp with new carbons which causes an excessive flame that gets in contact with the globe and in that way stains it. There is to my knowledge only one way to clean a globe in this condition, and that is by dipping the burned part in hydrofluoric acid. This acid is very dangerous to handle and much care should be exercised when it is used. As this acid will eat through most every material except lead and wax, it must be kept in a jar of that material. I prefer lead, as the acid gets warm when it acts on the glass, and I have seen cases where the wax melted and let the acid run out.

Now construct a round lead vessel about 6 inches high by 3½ inches in diameter (inside). Make this out of an ordinary lead pipe about 3½ inches diameter; after cutting it off, set it in clay or something similar, and pour melted lead in the bottom so as to form a bottom-side about ½ inch thick; be sure it melts together with the pipe and makes a good tight joint. Do not solder this bottom, as the acid will eat out the solder.

Now buy one pint of hydrofluoric acid and put enough in this lead vessel to cover all but ½ inch of the inner globe when it is inserted. The hydrofluoric acid is put in special prepared wax bottles, and must be handled carefully, especially in very warm places. If any acid should get on the hands, it is well to wash them in water at once and apply pulverized soda or something similar; it is well to have something of that kind on hand at all times.

Select a place for this cleaning where a draught can be created to carry off the gas fumes and, if possible, constantly running water; if running water cannot be obtained, get two large tubs of clean water, and next, boxes with perforated bottoms spaced off for about 25 globes each.

After selecting the stained globes, put on a pair of rubber gloves and commence work. First dip part of globe that is burned in acid (this will only take about 1 or 2 seconds in ordinary cases) then give it a liberal bath in the first tub of water. Now we may find a light white film on the globe which can be wiped off with a rag, and then dip in the second tub of water. After this, place it in the box with the perforated bottom; after the box is full take it to some warm place, say on top of a radiator, steam pipe, boiler, etc. After an hour the globes will be as good as new; perhaps some may need a little cleaning with a rag.

Some people advise, in place of using the acid in the manner above described, to use 10 parts of water to 1 part of acid, and place the globes in this bath; this method takes at least 10 minutes, and if several globes are in the bath at once, the chance of breakage is increased 50 per cent.

My method is perfectly safe and very efficient, if the above directions are followed as nearly as possible. The above suggestions may be old to many of my readers, but for those to whom they are unknown they will prove a means of overcoming a difficulty which has been experienced by all who operate enclosed arc lamps.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work—X[1].

BY A. E. DOBBS.

UNDERGROUND CABLES.

IT sometimes happens, even in small towns of 1,000 subscribers or less, that a new company will find in certain districts, so many poles and wires belonging to railroad, power, electric light, telegraph and other companies, that the least troublesome method is to put the cables underground. In some places, digging in unpaved back alleys is easy, and the work may be even as cheap as a heavy pole line, with the necessary span wires, slugging and guying.

Of course if the digging is hard, and pavements have to be torn up; that is another matter.

The cheapest duct, and about as good as any, is a creosoted wooden pipe. It needs no cement to hold it in place, for the dirt can be simply thrown back and tamped down on top of it. It will last a great many years, or at least, will not wear out in an ordinary lifetime. The joints should be sealed up with tar, or wrapped with burlap, to keep out dirt and water. In sections where lumber is cheap, a number of ducts can be "built up" in sections three inches square of plain rough inch or inch-and-a-half lumber, which may be tarred or painted. Do not fasten the cable in with pitch if you ever expect to draw it out again. If this kind of conduit is used, however, iron pipe should not be used in connection with it, unless sure that it will be perfectly free from illuminating or sewer gas as well as electrolysis. Many manhole explosions in cities can be traced to this cause. This is not to be taken as condemning iron pipe, but means that ducts exposed to gases should be either all of non-conducting, or all

[1]The writer wishes to acknowledge indebtedness to the Standard Underground Cable Co., of Pittsburg, Pa., and to John A. Roebling's Sons Co. for some of the suggestions contained in this chapter.

of good conducting material, to prevent a difference of potential and sparking between the cable and the duct tubes.

Suppose for example, we have several thousand feet of cable in wooden or tile ducts. Now, this duct being in the ground and more or less damp, would allow a certain amount of leakage to take place, so that if all the cables are connected together, a generator tried on the lead covering would show a very good ground, but this ground extends pretty equally over the entire system—for if a single cable were tried it would test "open"—and distributed in this way it is a very good thing as it clears out the static charge. It also prevents sneak currents from getting in, by interposing such a high resistance that they cannot get there in quantities in any one spot to do any harm.

Now, it often happens that at a manhole a cable is taken up a pole, or side of a building, and on account of its convenience in bending, an iron pipe is used. Suppose, now, as often happens, that the manhole gets just enough gas in it to become as explosive as gunpowder, and only requires a spark to set it off. Suppose again, that the lead covering of the cable receives a static charge from the overhead lines, or a back current from a street railroad track, or a cross with an electric light wire outside. With wooden or tile ducts it would distribute itself equally and harmlessly over the entire system, but with an iron pipe affording a fairly good ground, the visiting current goes that way with a rush, and as the inside of the pipe is apt to be more or less dirty and rusty, there will be just resistance enough to make a spark, and then—explode! If any of my readers have ever seen a manhole cover weighing 500 pounds and fastened down with heavy iron bolts, rise up in the air and land on the roof of a four-story building, I am sure they would consider this kind of a thing worth guarding against.

If all the ducts were of iron, it would also distribute itself probably without sparking, for the resistance of the lead cover to any but the heaviest currents is practically negligible, so that if the cables are all connected together, as they should be, the potential of the whole system is practically equal. But iron pipe exposes cables to stray currents and electrolysis from the trolley roads, and while there is a great deal of iron pipe used, I do not think its use is to be commended. There are iron pipes made with a glaze on the inside, and others lined with cement, but I cannot be convinced that they are as good as wood or tile.

The best but most expensive conduit now being laid is of tile or terra-cotta, with a smooth glaze on the inside.

It is never troubled by electrolysis, is a fairly good insulator, and never decays—though in cities where streets and alleys are continually torn up this is a doubtful quantity.

In order to make good work it needs to be laid in cement; though this depends somewhat on the nature of the soil. Conduits are also sometimes formed entirely of cement, the ducts being formed of paper or sheet iron tubes, and as its only use is to hold the form till the cement can set, it does not matter how long these frail tubes last. The size of the duct should not be smaller than 2½ inches, and 3 inches is better still. A tube that fits the cable too closely will be troublesome when drawing in, and a very little dirt may cause it to stick altogether. The duct might be made larger than this with the idea of carrying two or three cables, but this is not a very good plan, as all the cables would have to be pulled through at the same time; for another cable cannot be pulled into a duct after one has already been inserted. But there is no necessity for pulling two telephone cables into one duct if ducts enough are put down in the first place.

Always make allowance for four times as many ducts as you think can ever be used, for it costs no more to dig a trench for ten ducts than for three, and the only extra expense is for the tube itself. Besides, it may become necessary to change the cables some time, and in such a case an extra duct is very convenient.

It will not do to forget that with cheaper service the time will come when a telephone will be placed in every house, and while planning underground work, make the conduit capacity equal to the number of householders in that vicinity. Even with the high rentals prevailing in New York City, the conduit capacity in some districts has fallen far below the requirements, although at the time they were laid it was supposed there would always be some of them vacant.

In the early days of electric lighting in New York, Mr. Edison planned his system with the idea of supplying every house with light. This at the time seemed like planning a long way ahead, but in less than ten years even his far-sighted engineering proved inadequate, and his feeders had to be reinforced.

Why, in some Western towns where competition has cut the price of party lines down to $1 per month, half the houses in town already have telephones, and even farmers are waking up to the great convenience of this instrument, and some of my acquaintances are beginning to cater to this class of business.

All underground cables should have an alloy of tin in the lead covering, the amount being about three or four per cent. This applies to aerial cables as well, as pure lead, which is sometimes used, is too soft, and inclined to "creep;" but the real object of the alloy is to prevent corrosion. Sometimes the tin is put on the outside as a coating instead of mixed as an alloy. Customers can take their choice.

Bi-Metallic Wire on the Pennsylvania Railway Telegraph System.

The Pennsylvania Railway system has achieved, by careful management, the reputation of being one of the greatest railway systems of the world. Its splendid position is, no doubt, due to the careful consideration which has been given to many apparently minor details, resulting in the general good service for which this system is noted. Outside of the actual roadbed, building and maintenance of bridges, structures, etc., perhaps the most important adjunct to a railway line is the telegraphic service. Even though a superior mechanical system of block signals be in service, it is quite impossible in these days to operate a railway with certainty and despatch without the use of the telegraph. Hence it is that the telegraph plays an important part, and, because of its vital necessity, it is of the greatest importance that the lines should not only be well built, but should be built with the object of staying up, even under extraordinary stress of weather.

Mr. A. M. Schoyer, Superintendent of Telegraph, Pennsylvania lines west of Pittsburg, about a year ago placed bi-metallic wire in service on several of the branch lines of this great railway system in and around Pittsburg, and, because of the very satisfactory service which that wire rendered, he has recently introduced bi-metallic wire on the main line of the road between Pittsburg and Columbus, the size of the wire being No. 9, B. & S. gauge.

The splendid position of the Pennsylvania system to-day shows conclusively that the utmost care is exercised in conducting all branches of its business, and, because of the excellent service which that system renders to the public, it necessarily follows that any material which is used by it receives the stamp of approval of a company which is second to none. In view of this use it can be said that bi-metallic wire is now a standard type of wire for overhead construction.

A Simplification of the Marconi Receiver.

DR. H. RUPP, of Stuttgart, has made an important simplification in the Marconi receiving apparatus, which he describes in the "Elektrotechnische Zeitschrift." To restore the resistance of the coherer, Marconi, as is well known, employs an electric tapper, working like the hammer of an electric bell. This taps the coherer tube, loosens the filings and stops the current. This contrivance has been found to be somewhat uncertain in its action, and when a Morse instrument was used the dots and dashes were often not sufficiently separated.

Dr. Rupp dispenses altogether with the electric tapper in his

FIG. 1.—THE COHERER IN SECTION.

arrangement, and decoheres the filings by causing the tube to rotate on its axis. The rotation of the tube is produced very simply by means of the paper ribbon of the Morse instrument. The leading-in wires of the coherer are mounted in bearings, and a small vulcanite pulley, with flanges, is fixed on one end of the tube. The tube is put in circuit by two small copper springs, which rub on the rotating axes. The paper strip of the Morse instrument passes round the pulley between the flanges.

Fig. 1 shows this coherer partly in section. The paper spool of the Morse instrument is slightly braked by a brass spring, in order to produce a uniform tension on the paper ribbon, and

thereby a uniform rotation in the coherer tube. The arrangement of such a receiving station is shown diagrammatically in Fig. 2.

In the circuit of the coherer tube (F), there are, in addition to the battery (E), the resistance (W_1), and the relay (R). By means of the switch (U), either the calling up bell (L), or the Morse apparatus (M), with their respective resistances (W_2 or W_3), and the battery (B) can be thrown into the local circuit; W_4 is a resistance arranged in shunt to prevent sparking at the relay.

Such a station is called up when the tube is at rest, and the

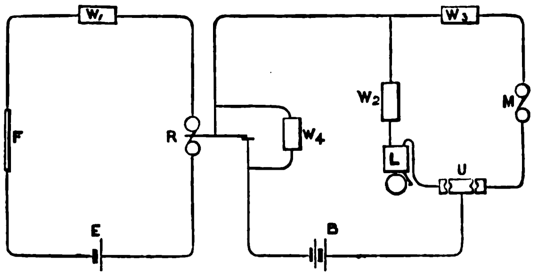


FIG. 2.—ARRANGEMENT OF THE RECEIVING STATION.

bell continues to sound until the Morse instrument is plugged into circuit, and the paper ribbon set in motion.

The diameter of the coherer tube to be employed in this way must not be too small, and the quantity of filings between the silver electrodes must be small enough to roll round the glass wall of the tube. When all the dimensions are properly chosen the dots and dashes stop at the right moment, and the signals are very distinct—certainly much better than with the old arrangement. We are indebted to the "Electrical Review," London, for the above translation and illustrations.

Adjustable X-Ray Tubes.[1]—II.

(Concluded.)

BY A. A. C. SWINTON.

In air at ordinary atmospheric pressure, the nearer the discharge points are together the more easily the spark takes place between them; that is to say, the shorter the distance the spark has to leap, the less is the difference of potential required to make it leap. Curiously enough in high vacua the exact contrary is the case, and the discharge passes with much greater difficulty over a short gap than over a long one. This may be readily

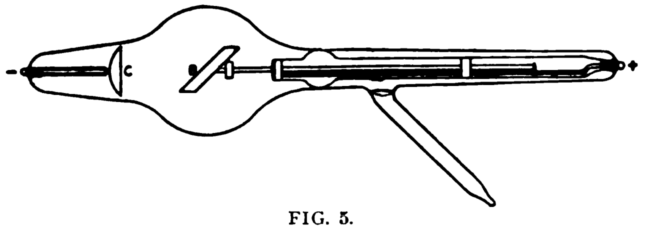


FIG. 5.

seen with an adjustable tube such as I will now show (Fig. 5), and in which I can alter the distance between cathode and anticathode by moving the latter. As will be seen when the distance is very small inside the tube, say only one-quarter of an inch, the spark prefers the alternative gap outside of about four inches, while if the internal gap is increased to about three inches, the discharge then prefers this path, and the exterior gap must now be shortened to about half an inch before the spark will travel that way. It is further found that, in a tube of this description, exhausted to a constant vacuum, the nearer the anticathode is moved up to the cathode and the higher the consequent resistance, the more penetrative are the X-rays; while moving the anticathode in the opposite direction, and thus making the distance greater and the resistance less, makes the X-rays less penetrative. This form of tube was the first adjustable tube designed and made in my laboratory, but this has now been superseded by others which have a greater range of adjustment, and are consequently to be preferred. One disadvantage that it possesses, is that the point of origin of the X-rays is moved for each adjustment. It has also the defect that, if the distance between cathode and the anticathode is made very great, so as to obtain much range, there is a tendency to a

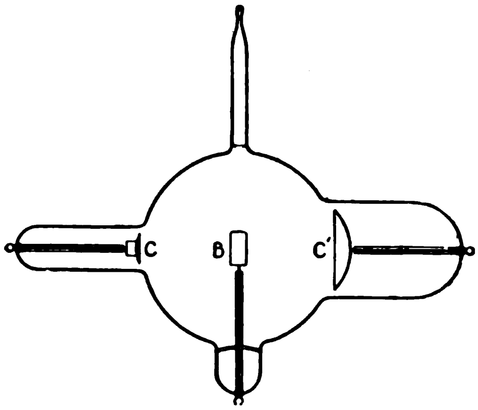


FIG. 6.

want of sharpness, owing to the X-rays being given off, not from a point, but from a considerable area. This, which has been observed in experiment, seems to show that, contrary to what has been stated by others, the cathode rays always do diverge again to some extent after passing the focus, though they do so at a greater and greater distance beyond the focus the higher is the exhaustion.

I have here an adjustable tube made by Messrs. John J. Griffin & Sons, which depends for its action upon the principle that I have just enunciated, namely, that the greater the distance between cathode and anticathode, the less penetrative, and the less the distance the more penetrative are the rays. In this tube, however, the anticathode is fixed, and it is the cathode that is movable, while the adjustment of the cathode is effected by the magnetic means, according to an ingenious suggestion of Dr. Dawson Turner.

The size of the cathode cup itself is also found to have a very

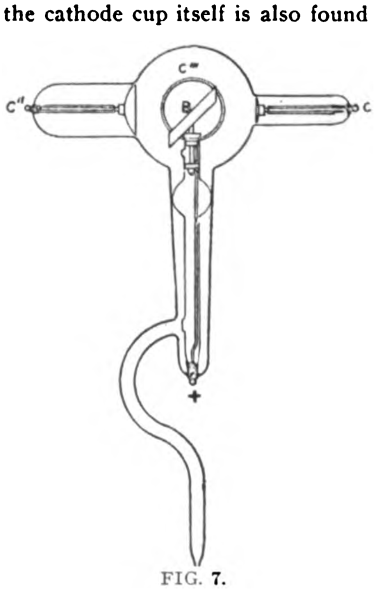


FIG. 7.

great effect upon the penetrative value of the X-rays produced in any given vacuum. I have here a tube (Fig. 6) which is furnished with two cathodes, both of the same curvature (0.75 inch radius), but one of much greater area than the other, the larger being 1.125 inch, and the smaller 0.375 inch diameter. Both cathodes focus upon opposite sides of the same anticathode, which is placed midway between them. All are in the same tube, and consequently in the same vacuum. If I connect the larger cathode, leaving the smaller one for the moment idle, you will

[1] A paper read before the Röntgen Society, London.

see that the X-rays produced are of a very poor penetrative quality, the result giving the appearance of too low an exhaustion. I now disconnect the larger cathode, and connect the small one. I now have an abundance of highly penetrative rays. I may further point out that the resistance of the tube as measured by the length of the alternative spark in air, is much less when the large cathode is in operation than when using the small cathode. Further, if this tube is more highly exhausted, so as to give rays of good penetration with the large cathode, the resistance with the small cathode is so high that the discharge will hardly pass at all.

I have here another tube shown in elevation and plan in Figs.

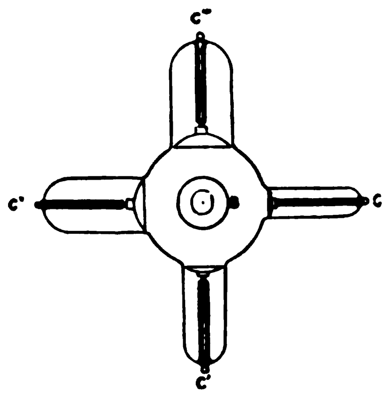


FIG. 8.

7 and 8, fitted with four cathodes of 0.5 inch, 0.75 inch, 1 inch, and 1.125 inch diameter respectively. They all have the same radius of curvature, i. e., 0.75 inch, and all focus upon the same point on the anticathode, which is mounted upon a spindle, so that it can be turned round so as to face any one of them. With this tube, as with the last shown, it is found that the larger the cathode the less penetrative, and the smaller the cathode the more penetrative are the rays produced. There appears to be no advantage in employing extra large cathodes, even when the exhaustion is made to suit them. Experiments with various sizes, from 2.5 inches diameter down to 0.125 inch diameter, go to show that even with the full power of a 10-inch induction coil with mercury break, there is no advantage in making the cathodes more than 1.125 inch diameter. For use with a 10-inch coil they should not be smaller than about 0.375 inch diameter, as, if less than this, they are apt to become overheated, and their surface and form destroyed. For use with 6-inch and smaller coils, very small cathodes, even down to 0.125 inch diameter, will work very well, and will not require such high exhaustion as larger ones. Small cathodes should, in proportion, have a less focal length than large ones for the best results. Probably, a good average size for ordinary work is about 1.125 inch diameter, and 0.75 inch radius of curvature. It is important for the best work that the surface should be well polished, and to be of quite even curvature.

Another simple and, in my opinion, altogether superior form of adjustable tube, which has the advantage of a fixed point of origin for the X-rays, and which has a great range of adjustment, depends for its action upon the fact that the resistance of the tube and the penetrative value of the X-rays that it generates can be greatly varied by altering the radius of the annular space

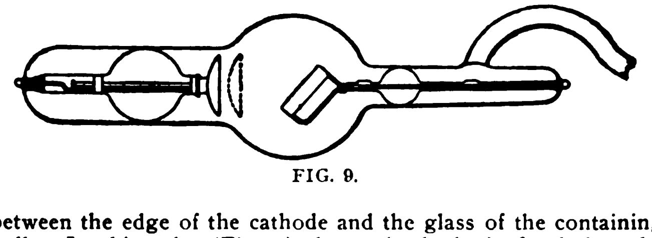


FIG. 9.

between the edge of the cathode and the glass of the containing bulb. In this tube (Fig. 9) the anticathode is fixed, but the cathode is mounted upon a steel rod, held in guides, so that by gently tapping the tube the cathode can be moved to a small extent—say, about one-half of an inch—in and out of an annex, blown on one side of the glass bulb. The shape of the walls of this annex are such that when the cathode is at one end of its travel, and as far as it can get from the anticathode, the edge of the cathode is very near the glass all round; while as the cathode is moved nearer to the anticathode the annular space between the cathode edge and the glass becomes larger and larger, until at the other end of the travel the cathode emerges from the annex into the bulb itself. With a tube of this construction, the greater or less proximity of the glass to the cathode is found to have a much larger effect in increasing or decreasing the resistance of the tube and the penetrative value of the X-rays than the contrary result that would be occasioned by the alteration in the distance between cathode and anticathode. A travel of one-half of an inch is sufficient to alter the X-rays from the highest to the lowest penetrative value, and between the limits of travel any desired degree of penetrative value is immediately obtained. The adjustable tube just shown was made in my laboratory, but here are two others on the same principle, made respectively by Messrs. W. Watson & Sons and Mr. Cossor, who have kindly lent them to me for exhibition.

In conclusion, I should like to lay stress upon the great importance of good and accurate workmanship in the making of X-ray tubes if the best results are to be obtained. In no instrument is work of the cheap and nasty description more to be deprecated. Bulbs should be of uniform thickness, and as thin as will bear the atmospheric pressure. Cathode and anticathode should be placed axially so as to produce accurate focussing, and so that they are symmetrical with the glass. The platinum leading-in wires should not be too small, or by becoming overheated they may crack the glass. The cathode and anticathode should be substantially supported so that they cannot become displaced. The cathode should not merely be roughly stamped out of sheet metal, but should be turned up and polished on a lathe to a true spherical surface. The terminals should be substantial and a long distance apart so as to preclude sparking between them.

As the application of considerable electrical power is found in practice to give the best results, the anticathode should be of sufficient mass not to readily become overheated or deformed. The exhaustion should be most carefully carried out, till as far as possible a permanent degree of vacuum is obtained. Even if tubes made in this way cost more than others, they will give much superior results. They will also prove much more durable, and will in many cases stand being re-exhausted many times. Finally, if eventually the glass is cracked or broken, or becomes too much blackened, the cathode and anticathode will serve again to make another tube.

I trust that I have not wearied you with too much detail, but it is upon detail chiefly that success depends—at any rate, so far as X-ray tubes are concerned—and, after all, of all the apparatus that the practical user of the Röntgen rays employs, the tube is the most important, and perhaps I may say also, the least generally understood.

I must mention, in conclusion, how much I am indebted to the untiring assistance of Mr. J. C. M. Stanton and Mr. H. Tyson Wolff, who have made and exhausted all my experimental tubes, and without whose willing aid I do not suppose I should ever have attacked these very difficult problems.

Electrical Men in the Volunteer Army.

Besides the large number of electricians enrolled in the Engineer Corps of the Volunteer Army, we are glad to note not a few electricians in camp forming part of the militia regiments that volunteered in a body. At Camp Townsend, Peekskill-on-the-Hudson, we find the genial Mr. Robert Edwards, Jr., of the firm of Edwards & Co., Captain of Company B, 8th Regiment. In the same regiment, acting as Corporal, is Mr. M. A. Gilmour, of the Western Electric Co.; also Mr. Shearer, of the Western Electric Co. Mr. E. W. Rockefellow, of the Western Electric Co., is First Lieutenant of Company B, 47th Regiment. Mr. J. M. Larvens, purchasing agent of the New York Electric Equipment Co., is 2d Lieutenant of Company B, 47th Regiment.

MR. WALTER A. CROWDUS, electrical and mechanical engineer of the American Electric Vehicle Co., of Chicago, has resigned his position to devote his time to European negotiations for his electric storage battery. He will pay the Electrical Exhibition a visit en route for London.

It is not expected that the work on the extension of the third-rail system of the N. Y., N. H. & H. R. R. to Bristol will be finished before July 1, so that cars can be run. The line from New Britain to Plainville is finished.

THE

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Died For Their Country.

EVERY electrician will grieve at the news of the death of the two Edison Co.'s electricians, who, while working down the Bay, laying torpedoes off Sandy Hook from a small boat, were run down by the French liner "La Touraine" and drowned. The men were Robert Middleton, married, and Victor Posso, single. Thus the war has claimed its first victims in the vicinity of New York, and from the electrical ranks. The incident, sad as it is, is but one more proof of the active part that electricity is playing in this war, and of the readiness of electrical men to stand up and be counted in. It is, indeed, a pity that more of them are not with our fleets, for it is evident that in cable laying, cutting and repairing they could do useful work.

As to the present incident, we can only trust that the men do not leave behind them relatives without support. The generosity of the Edison Co. is well known, and if other aid is needed, we pledge The Engineer to do its share in securing relief for the families of those who have thus died for our protection, at the post of duty. Those families should certainly be entitled to pensions.

"Features" at the Electrical Exhibition.

THE many-sided nature of electricity is admirably brought out at such an exhibition as that now being held in Madison Square Garden. It is said to have been one of the desires or ambitions of the management not to repeat any one "big" feature of the show of 1896, while presenting many things not then included; and they have been highly successful. Of course not everything has come out on the same plane of brilliancy and smoothness of result. That would have been too much to expect, for where a great deal is attempted a margin of disappointment is inevitable. But it is only fair to say that nearly every item of novelty has shown distinct merits as an attraction, and that in instructive variety the Exhibition of 1898 is vastly superior to that of 1896, which set a pace very hard to beat.

In reality, it is worth while to study the attitude of the public as exemplified on these occasions. Does it merely want to be shocked and startled, or does it come for solid instruction and rational entertainment? The latter is surely the case. That a large proportion of the visitors should go away, after all, without any clear idea of what it is all about, is only natural, but it is impressive to note how thickly the crowd gathers the moment any exhibitor gives a lucid explanation of what his apparatus will do, and how it is done. The beautiful Schoonmaker exhibit of the "field of force" appeals very strongly, for example, even to medium intelligences, and once the notion of the way magnetism acts is implanted, the other steps of comprehension are found easy; while the next door exhibit of the Edison ore separation drives the lesson home in a practical way. By slow degrees, knowledge of a special kind permeates the mass of the community, but the process is inconceivably quickened by such a brilliant, varied and instructive exhibition as that at Madison Square Garden. It is popular education on the largest kind of scale, and it would certainly be impossible to render instruction more palatable and attractive.

The Compound Winding Patent Void.

ANOTHER "controlling" patent has been declared void and in such unmistakable manner that there can be no possible hope for its rehabilitation by a higher court. This time it is the Edison "compound winding" patent which the General Electric Co. has so long held as a club over the heads of its competitors. In deciding against the validity of the patent Judge Coxe, as it were, affirmed the decision rendered on the same patent in the English courts where, after fierce litigation, the bill of the plaintiff was dismissed. In both these celebrated cases the Brush "teaser" patent was held to be a plain anticipation. The attempt to hold the Edison claim for the combination of a compound wound dynamo with lamps connected in parallel, was likewise rejected, and with incontrovertible arguments. We are not informed as to whether the General Electric Co. intend to appeal the case to a higher court, but we can not but contemplate with sadness the large expenditures which the trial of this case involved both to plaintiff and defendant, especially in view of the fate of the patent abroad. Thus, one after another many so-called controlling patents of the General Electric Co. have been reduced to a mere shadow of their former number and potentiality. Now that most of them are no longer available as fighting material in the war of commerce, we may look for a more natural and healthy tone in the trade, with the judgment of intending purchasers untrammeled by suits for infringement looming up before them.

Inductor Alternators.

THE electrical arts have fortunately not reached a stage where improvements are slow and designers are completely satisfied with existing types of apparatus. On the contrary, the progressive spirit is as keen as ever, resulting in a constant improvement along the lines of durability and efficiency. In the department of alternating current machinery the lapse of time with its accumulated experience had some time ago shown the weak points of the early designs of generators. The constantly increasing voltages adopted have still further accentuated these defects. While, of course, theoretically there are no limitations to the insulation thickness to withstand any desired potential yet practical considerations soon mark the line beyond which the separation between copper and copper and copper and iron commercially become prohibitive. The history of the transformer early proved the superior resistance to breakdown which a stationary coil of given insulation possessed over a moving one of like construction. This led to the design of alternators in which the magnet system with its coils is revolved and the armature system is kept stationary. Several excellent machines have been designed on this principle. But the trend towards

absolute suppression of movement for all the coils of alternators is strongly shown in the increasing popularity of the inductor machine. This type is by no means a new comer in the field, but it has taken a long time to bring its full merits to the front. The reason for this must be plain, for, besides the, no doubt, important question of insulation it presents electrical and mechanical advantages of no small degree. Though the inductor machine found its first advocates abroad, its prophets found no honor in their own country and it has remained for America to demonstrate fully the true value of this machine to which the improved methods of construction employed have contributed not a little. Already a number of our manufacturers have adopted such designs as standard, while others, we understand, are preparing plans for bringing out such machines. It is not likely that the inductor machine will entirely displace the types of machines now in vogue, but there is little question that it appeals strongly to the instincts of the central station man and the private plant owner and that, other things being equal, it will always command something more than respectful consideration.

The N. E. L. A. Chicago Convention.

THE approaching meeting of the National Electric Light Association at Chicago promises to be one of the best attended of the many successful gatherings of that body. The central location of the meeting at the Western metropolis will of itself attract many who have for several years been forced to forego attendance. But aside from this the programme of papers, topical discussions and entertainment arranged for by President Insull and his fellow officers, will serve to bring to Chicago many to whom the Association's meetings have become a distinct boon. Moreover the intercourse with others engaged in the same industry, the exchange of ideas and experiences have a value which has more than once been expressed on the floor of the Association. Then again, the always welcome salesman, with the latest improvements in apparatus will, as heretofore, serve to bring the central station operator up-to-date.

MUNICIPAL AFFAIRS

Municipal Electric Lighting.

BY "ELECTRIC."

I have read with interest the articles under above caption, written by Mr. Bowker, on the one hand as against the municipal ownership of electric light plants and the reply of Professor Commons. I wish to call attention to one phase of this question, and one to which Professor Commons, to my surprise, in his first article in The Engineer of February 24, seems to lend his countenance, viz., where he writes: "I agree that Government, whether national or local, cannot safely undertake experiments on a large scale. But in the sense in which I use the word, the introduction of new modes of manufacture or service and the creation of new wants among the people are matters involving risks of an incalculable and speculative kind, and this is not the business of the Government. Private parties should be encouraged to push forward in all the untried fields."

This will apply to parties who in the early days of electric lighting had enough enterprise and push to invest their money, but who, according to Professor Commons, must now be supplanted by the municipality, and those also who have ventured in localities where for years the investment was not profitable, but as soon as the same does show signs of self-sustaining abilities then should the municipality step in and occupy the field.

I have no disposition to argue the question as to its bearing of cost. I do not think that is the pinch of the case, so far as electric lighting companies are concerned. It is a question whether their property shall be confiscated or not, and a protection from this possibility should be endeavored to be had in all our States. This could be done in about the same manner that is now pursued in condemning private property for public use. As it is now, the municipality can, when authorized to go into the business, render the plant in the community worthless by buying a new outfit, when the one already installed would serve their uses just as well. It may be said that the municipality would prefer buying the installed plant, but my observation has been that they always expect to instal a new plant. Oftentimes the agitation is the result of selfishness or jealousy, or both combined.

Where there is no private corporation doing electric lighting it is entirely a local question whether it should be done by the community or private enterprise, but once the choice has been made and franchise given and a plant installed by private corporation, then it should receive protection under the laws guaranteeing it from what becomes virtual confiscation, viz., municipal ownership in its territory.

This is not a question of cost, but a question of simple honesty, and one which our electric light people and journals ought to be forcing and agitating until we are protected from this threatening danger which continually hangs over our interests.

LITERATURE

DER ELEKTRISCHE LICHTBOGEN (The Electric Arc). By Prof. Dr. Ernst Voit, Stuttgart, 1896. Ferdinand Enke. 74 pp., 6½x10 inches. Paper. Price, 50 cents.

This pamphlet is the first of a series of lectures on electrotechnical subjects, issued under the supervision of Dr. Voit. In this one the author has attempted to gather all reliable data on the electric arc and present them in connected form, giving the most trustworthy results the greatest prominence. Like all German works of its class, this little book evinces extremely painstaking and laborious research, beginning with the discovery of arc phenomena by Volta in 1800, and including the vast amount of work done since then up to the present.

The first few pages deal with the historical development of the electric arc, and contain a general description of its outward characteristics, and of the most usual varieties of carbons employed, after which the author plunges into those intricate phenomena which have made the arc one of the most investigated, but least understood, phenomena of electrical science. By means of curves, which show the relations of the variable quantities in the arc with reference to each one of them in turn, Dr. Voit has presented in striking and comprehensible form, facts which lie hidden in countless tables and treatises.

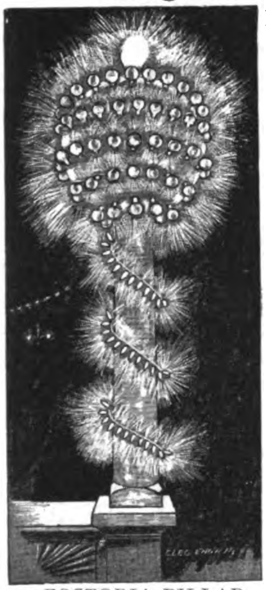
Nevertheless, the results here presented as trustworthy should not be taken as generally applicable. Unfortunately the author does not give all of the conditions under which the experiments were made, such as the amount of resistance or induction in the circuits, the temperature and density of the air, the direction and intensity of air currents, if any, nor the details of the arc lamp and dynamo mechanisms used in the tests. More important still is the failure to describe the means by which current and voltage were varied.

In spite of these omissions, this work must prove of great value to any one interested in the open arc theoretically or practically, owing to the thoroughness of the research and the weeding out of masses of useless or even misleading data. At the time that this treatise was written the enclosed arc was too new and too little understood to obtain recognition, which accounts for Dr. Voit's failure to give it any consideration in what is otherwise a most comprehensive review.

JOSEPH BIJUR.

NEW YORK.—I read The Electrical Engineer each week and consider it a reliable and thoroughly up-to-date journal.—A. B. Rodriguez.

Doings At the Electrical Exhibition.



FOSTORIA PILLAR.

THE past week was a busy one at the Electrical Exhibition, and although the weather was simply outrageous best part of the time, the crowds thickened as soon as there was any promise of a change for the better. The chief events of the week were the lecture by Dr. S. S. Wheeler, the Gramophone Concert with the help of the famous Banda Rossa, and the Telegraph Tournament on Saturday night. The current week opens with a phonograph concert on Monday night by experts from the Edison Laboratory, and that will be followed up by popular lectures and special entertainments of various kinds.

During the week many additions were made to exhibits we have already described. An interesting addition to the exhibit of the New York Telephone Company is a collection of special apparatus for telephone communication under peculiar circumstances. Among this unique collection will be found a complete installation for maintaining communication between the diver at work and those in charge of the air pumps and life lines on which the safety of the diver depends. The diver's helmet contains receiver and transmitter so placed as to be always in position for use. The wires pass through the hose pipe to the telephone set and batteries on the boat. This outfit is shown fitted up for use in a life-size diver's suit. Another telephone set of a form rather unusual to those accustomed to have their telephones fixed on the wall or standing on a desk is mounted in a massive brass standard some four feet high, which to all those who have been at sea at once suggests the fittings of a ship's bridge. This is the marine set used for communicating between the bridge or conning tower and all the multifarious departments contained in one of Uncle Sam's "ironsides." Several United States warships are fitted up with a telephone system of this order. Another warlike telephone set is the "field set," which contains telephone stations, batteries, signaling apparatus and line wire all in one complete outfit. The wire is on a reel to be slung over the shoulder of the scout or orderly, who becomes a moving telephone station keeping up constant speaking communication over the wire as he pays out the terminal in the staff headquarters. A more peaceful application of the ubiquitous telephone is a mining set in which the delicate telephone instruments are enclosed in a substantial waterproof case to protect them from the rough usage and dampness met with in underground works. The special telephone apparatus attracts much attention to the exhibit of the New York Telephone Company, interesting enough in itself as it is a working telephone exchange giving exhibitors in the Garden communication with the rest of the city all day long.

H. B. Coho & Co. added a distinct novelty to their fine exhibit in the shape of a plate glass switchboard, probably the first ever made. It is trimmed with brass, and presents a remarkably neat, trim and cleanly appearance. All the connections are, of course, in full view, and therefore less liable to get out of order from dirt or neglect.

Another fine new exhibit is that of X-ray work by Dr. W. J. Morton, including a full size photograph of a woman made on one film; a "bicycle foot," a curvature of the spine, and a

GENERAL VIEW OF MAIN FLOOR, MADISON SQUARE GARDEN.

woman's body showing the effect of the use of corsets.

War bulletins were set going on a stereopticon screen during the week by Mr. Gould W. Hart, under the direction of Mr. C. Chamberlain, the press agent, who received the news by telephone from such offices as the "Herald," "Times," "World," etc. These were interspersed with war pictures. In addition lantern displays were given from time to time in the Concert Hall. On Friday evening the gramophone concert proved a success, drawing a large audience to hear the music and explanations. During the week the Edison Electric Illuminating Co. established 5 o'clock tea, started a printing press on war bulletins, and introduced an electrically played piano, all of which innovations were highly appreciated, not only by visitors, but by the regular attendants.

Prof. R. B. Owens, electrical commissioner of the Omaha Exposition, was a visitor to the Exhibition last week, and was extremely pleased, characterizing it as finer than the Electricity Building of the World's Fair of 1893. He had several interviews with exhibitors as to transferring their exhibits to Omaha in June.

One of the striking and encouraging features of the exhibition has been the practical success of the exhibitors. An unusually large proportion of the crowds drawn to the Garden is composed of well-to-do people, engineers, architects, artists, etc., who not only inquire critically, but make frequent orders and contracts. Many of the pieces of apparatus have been sold already, and the inquiries afield are innumerable. In addition to this there are a great many visitors from abroad, in spite of the warlike times, and they are on the alert for novelties, specialties and agencies of all kinds.

The Headquarters of the New York Electrical Society.

AT one end of Newspaper Row, in the Arena Circle, the New York Electrical Society has its handsome headquarters, of which a view is here given. The secretary, Mr. George Heli Guy, is in constant attendance, and has the help of Miss Stack as an assistant secretary to answer the innumerable inquiries of members and visitors. Mr. Koch is also present to look after some of the "features." The space has been divided by Mr. Guy into two parts, the smaller of which serves as an office, and contains typewriting machine, etc. The larger space is furnished with chairs, etc., laid with rugs and decorated with palms. Over the booth is the sign of the society, and in front are two very handsome McIntire enclosed arc lights on ornamental standards.

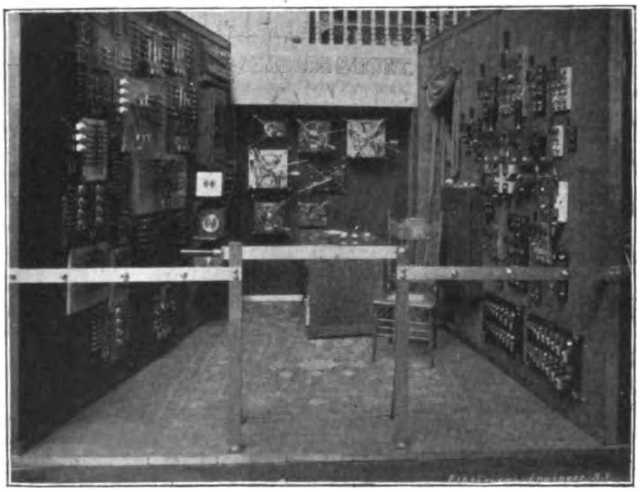
THE NEW YORK ELECTRICAL SOCIETY'S BOOTH.

The back wall has framed groups of the past presidents and present officers of the society, and the message of President McKinley opening the Exhibition. In front of the booth, just within the rail, stands a table holding, under a glass case, the golden key used by Mr. McKinley and previously used also by President Cleveland in opening the Chicago World's Fair in 1893. At the other side of the front rail is an Edison phonograph operated by Chloride accumulator and carrying the wax cylinder on which is the message to the society from Vice-President Hobart.

The society has done excellent work in behalf of this Exhibition held under its auspices, and is reaping already some of the fruits of its work. During the last few months, new enrollments of fifty members at a time have not been infrequent, and last week the secretary submitted a list of 103 proposals for the month! During May a series of lectures is being given in the Concert Hall by the society, the first of which was that by Dr. S. S. Wheeler, noted elsewhere. The society has opened a register at its booth and hopes to have it contain the name of every member before the Exhibition closes.

Exhibit of Zimdars & Hunt.

THE exhibit of Zimdars & Hunt has called forth much favorable comment from visitors to the Exhibition. Situated on the 26th street side not far from the main entrance, it is one of the exhibits first met with by the visitor in his tour, and the



ZIMDARS & HUNT'S EXHIBIT.

glittering array of bright copper objects attract his eye before he has come up to the booth. Upon closer observation these objects are seen to be a display of the panel boards, switches, automatic motor starters, etc., which have given this firm such an enviable reputation. Here will be seen one of the most complete exhibits of panel and feeder boards heretofore attempted, all of the very latest forms, as well as the older and better known types being shown mounted on marble and slates in innumerable variety.

In the rear of the booth all types of the well known Zimdars & Hunt automatic switches and motor starters are shown. These devices are now so well and favorably known that it might be expected that they would have no special interest here for the technical observer, but this is not the case, for there are here to be seen many new types recently brought out, and which contain many new features of merit. A new type of automatic motor starter, known as Type D, is here shown for the first time, and so well has it been received that the firm have already received many orders for them in their various sizes. One wall of the booth is almost entirely taken up with a display of knife switches, lugs, connections, etc. These will well repay a close examination, as the closer they are examined the more clearly will their many valuable features be brought out. All types are shown, and in the various sizes. The copper back connections which this firm has recently introduced also come in for considerable attention here. The instrument switches should be examined by those not already familiar with them. These, though but recently introduced, have so many points of superiority clearly evident that they immediately jumped into the favor of engineers and contractors, and one now looks for them on the latest and most up-to-date switchboards.

In addition to the above there are many other devices of real merit on exhibition here which the visitor will do well to look up.

The booth is enclosed at the front by copper bars representing switchboard bus-bar work, a gigantic knife switch serving for a gate.

The exhibit is in charge of Mr. J. T. Hunt, assisted by Messrs. T. J. Martin and W. S. Atkinson.

The Edison Process of Magnetic Ore Separation.

UNDOUBTEDLY one of the most interesting exhibits on the main floor is that of the Edison process of magnetic ore separation, which is associated in a manner, and very appropriately, with that of Mr. E. T. Schoonmaker to demonstrate the magnetic field of force. But one is led up to the exhibit, made by the Exhibition Company itself under permission from Edison, very gradually. Outside the Garden, on Madison

MR. EDISON'S MODEL IRON-ORE CRUSHING PLANT.

avenue, is a huge block of iron ore rock weighing eight or nine tons. The Garden management objected to its entrance, so there it stands, a telling advertisement of the huge power that Mr. Edison applies out at his Jersey mines, as these blocks are handled by his excavator and crushed by his giant rolls. Over the rock hangs an inscription. Then inside the main approach are two more such playthings also labelled; and then, at the space itself, are two more, not quite so large, but still of such size that half a dozen of them would build a snug church.

The picture herewith shows the tasteful exhibit, which is draped in red. On the walls hang wash drawings of the works at Edison, N. J., loaned by McClure's Magazine, and a photograph of an immense cement foundation made out of Edison sand or sifted crushed rock. On a ledge around the exhibit are placed a series of large glass bottles showing the sand in various meshes, the separated iron, the briquettes, etc. On one of the rocks are placed some trays showing the rock and iron, so that it can be handled, and to illustrate the contrast between the big boulder and the sand it is smashed into, sometimes at the rate of 60 tons in 11 minutes. The exhibit has enjoyed throughout the competent and intelligent attention of the well known electrical engineer, Mr. Francis R. Upton, assisted by a student from the Hebrew Technical Institute, and has been visited by Mr. Mallory, of the works. The central model is driven by a small Paragon motor, and the gearing to handle the sand, etc., so that the process of separation can go on indefinitely, was fitted by the veteran model makers, Wm. Gardam & Son, of this city.

The model shown, built by Mr. Sigmund Bergmann, of the Incandescent Arc Light Company, and loaned by Mr. W. S. Mallory, vice-president of the New Jersey and Pennsylvania Concentrating Works, is intended to illustrate the principle upon which Mr. Edison's process of magnetic ore separation is based. There are deposits scattered through the United States of iron ore which is magnetic. The iron is intermixed with rock, and the difficulty is to separate it cheaply, so that it can be made useful. Mr. Edison has bought up many square miles all over the Union, and is working now on veins in the mountains near Lake Hopatcong, New Jersey, where his property contains 200,000,000 tons of iron rock suitable for crushing. The rock is magnetic in a feldspar gangue, which runs about 25 per cent. of oxide of iron. Mr. Edison's plant will easily handle 4,000 tons of crude ore a day, and human labor has been eliminated from the various processes up to the furthest point. The rock is first slightly loosened by dynamite, then excavated from the face of the vein by huge steam shovels, hauled on skips to the crushers, and then passed through different rollings and crushings. There is one mile of electro-magnets in the plant, and the crushed rock passes before the magnets several times, in the exact manner shown by the model, until it has thoroughly separated from the rock and has become purified or concentrated. The crushed rock or sand falls straight; the particles of iron are deflected or curved inward by the invisible attraction of the magnets, and thus the separation is effected. Every four tons of rock will on the average yield one ton of high grade concentrate and three tons of sand, the percentage of oxide in the final concentrates being from 91 to 93 per cent.

The concentrated iron is next mixed with a "binding" material and then the pastelike preparation is carried to molding machines, where, under pressures running up to thousands of pounds on the whole diameter, it is converted into briquettes, each briquette weighing a little over one pound, and measuring 1¼ inches by 3 inches. These briquettes repel water absolutely. They are dried and hardened by passing slowly on belts through a huge furnace for one hour, subject to a temperature of not less than 600° Fahr. They are then automatically loaded into the cars waiting outside the works to convey them to the blast furnaces of Pennsylvania.

The sand is meantime conveyed automatically outside the plant and dumped. It is highly prized for building (being sharp and crystalline), for track sanding, etc. Other parts of the refuse are also utilized. In fact, everything ground up has a marketable value. The various processes embodied in the plant have been worked out by Mr. Edison in experiments and tests extending over many years, and a great many inventions of his enter into each stage of the work.

Exhibit of the Weston Electrical Instrument Co.

THE Weston Electrica Instrument Co. have arranged a very attractive exhibit which includes the latest models of both their portable and station instruments. Among the latter may be noted the large potential indicator in the centre of the board, the diameter of the scale being 3 feet. Several large ammeters for high current measurements are shown, together with the well known B and F type of station ammeters and voltmeters. The switchboard is also mounted with the large models of the Van Vleck type. These attractive and neatly designed instruments have become famous to the engineering world in many

WESTON ELECTRICAL INSTRUMENT CO.'S EXHIBIT.

installations where questions of economy have been vital considerations. There are also displayed their well known portable types of alternating and direct current apparatus, including ammeters, voltmeters, millivoltmeters, milliammeters, portable galvanometers, ohmmeters, lamp measuring instruments, voltammeters, shunts, multipliers, etc. Among the latest types of direct current instruments is shown an ironclad portable voltmeter. It contains the regular mechanism, but is completely enclosed in an iron case, screening it from all external forces, making it a valuable instrument when used in central station work or

under other magnetic influences. The ohmmeter which is shown is remarkable for its uniform scale, and being similar to the voltmeter in its construction possesses the qualities of that standard instrument. Giving as it does a direct and immediate reading of the resistance in ohms its usefulness is readily appreciated, especially when compared to the work necessary to manipulate a bridge set. It is especially advantageous, when it is desired, to measure like resistances which are to be quickly made as in the lamp industry. Special attention has been given to milliammeters—a special instrument being shown which is used in dental cataphoresis giving readings as low as one-fiftieth of a milliampere. The attractiveness and durability of the portable instruments have been increased by the new royal copper finish. Included in the exhibit is a complete display of the numerous parts of the various mechanisms illustrating the refinements in accuracy of details which characterize the excellent mechanical construction, and which have won for this firm an enviable reputation. This splendid exhibit is in charge of Messrs. Mohr & Koch.

The Exhibit of the Crocker-Wheeler Electric Company.

ONE of the largest, most complete and interesting exhibits on the main floor of the hall is that of the Crocker-Wheeler Electric Company, of Ampere, N. J. In the space occupied by this progressive company are shown motors and dynamos of numerous sizes and types; and the distinction of showing the largest electric generator at the exhibition belongs to this company. It is sold to the New York Central R. R. for the renovated Grand Central Depot, and is a 150 k. w. direct connected type generator, of which the company build seven sizes, namely, the 300, 200, 150, 100, 75, 50 and 30 k. w., varying in speed from 100 to 300 r. p. m. There are also shown 1-12, 1/6, 1/4, 1/2, 1, 2, 3, 5, 7½, 10, 15, 25, 35 and 100 h. p. motors, so well known as to require no further mention here. An 8 h. p. mill type motor is shown which closely resembles a railway motor, being entirely ironclad and intended for use in rolling mills, cranes in mill yards and other dirty, dusty places where it is necessary to protect the moving parts of the motor from particles and from moisture. A 50 k. w. direct connected type dynamo is shown in sizes 1/4, 1 and 5, and motor dynamos, sometimes called double field direct current transformers, are also exhibited. The uses to which they are put are numerous, one of the principal uses being as "boosters" on long electric supply circuits. In addition there are a 7½ h. p. motor with automatic brake; size 22 (14 h. p.), elevator motor, which is distinguished by the fact that it will start under full load with no excess of current above that needed for its operation at full load; sizes ½-100 and 1-100 direct connected type motors. A commutator for a 300 k. w. machine which is a model of workmanship and mechanical construction. A size 1 dynamotor, with automatic circuit opening device and 1-12 h. p. and 1/6 h. p. bracket fan outfits, so well known to the trade, as well as the public. This very complete exhibit, which is in full working order, and is itself a course of instruction in dynamo-electric machinery is superintended by Messrs. Wheeler, Blackall, Doremus, Pedersen, Bates and others.

EXHIBIT OF THE CROCKER-WHEELER ELECTRIC COMPANY AT MADISON SQUARE GARDEN.

The H. B. Coho & Co.'s Exhibit.

H. B. COHO & CO., No. 30 Cortlandt street, New York, with their usual push, have made a very creditable display of the large line of apparatus which they handle. The principal features of their exhibit are the apparatus of the Eddy Electric Mfg. Co., Windsor, Conn., consisting of a full line of dynamos and motors and electroplating apparatus. These include their new six-pole machines for direct connection, their new double voltage plater, and new line shaft motor. There is also a 75 kilowatt Warren alternator working 1,100 and 110 volts off the same machine, driven by an Eddy motor, in actual operation.

The Crown Woven Wire Brush Company, of Salem, Mass., exhibit a full line of motor and dynamo brushes of various types and designs. There is also shown a Van Horne, Berger & Co. gas engine direct connected to a 15 kilowatt Eddy dynamo, which is something new in the market; and from the general appearance and guarantee of close regulation this outfit will surprise some of the gas engine as well as some of the steam engine people. The display of ceiling and column fans of the well-known Crescent type is also a special feature of the exhibit.

The Pennsylvania Electric Co., of Marietta, Pa., are showing a full line of their telephones, and the illuminated sign of H. B. Coho & Co. is composed of translucent fabric, a substitute for glass, which is rapidly being taken up for use in skylights and is manufactured by the Translucent Fabric Co., of Quincy, Mass.

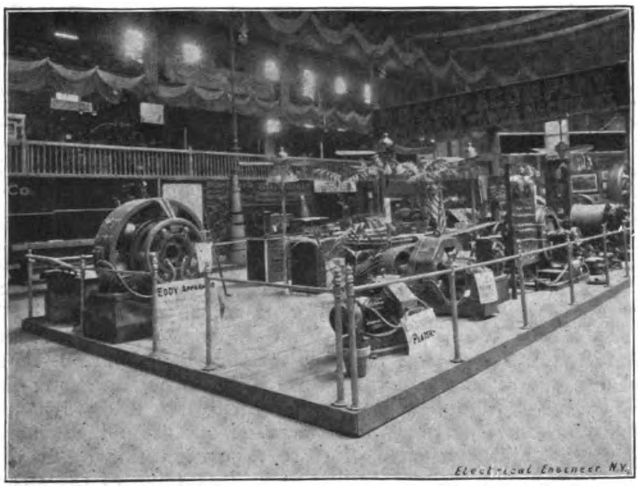
The American Rheostat Co., of Milwaukee, Wis., are exhibiting a 3 h. p. 500 volt automatic starter, and a 20 h. p. 230 volt overload starter. There are also shown a 50 h. p. 125 volt automatic starter connected to an Eddy motor; a 5 h. p. 220 volt perfection rheostat, which is constructed so that it fulfils the duties of a main circuit knife switch, fuse block, starting rheostat with automatic overload and automatic release, and fulfils all the requirements of an automatic double pole circuit breaker. The box is an entire switchboard in itself and is of neat design. Then there are shown a 2 h. p. 230 volt reversible printing press controller, and a 10 h. p. 230 volt reversible elevator controller, provided with an overload safety device, and a 40 kilowatt 125

volt rear of board field rheostat of their own design. They are of fireproof construction throughout and are made to meet the requirements of the trade and the insurance authorities.

The exhibit of Otis Bros. & Co. consists of a complete private elevator outfit of actual size and a working model. It is equipped with the Otis improved push button device, placed in each hall near the elevator shaft. The car is brought to the floor at which the button is pushed, provided all doors leading into the elevator shaft are closed, and no door in the elevator shaft can be opened unless the car is opposite the landing at which it is desired to open the door. Inside the car are placed separate buttons, by pressing which the occupant of the car can bring the car to the desired landing, each button being numbered to correspond to the floor to which it will bring the car, and when the car arrives at such floor it will automatically stop. The buttons in the car are also inoperative if any door in the shaft is open. When the car is moving it is entirely under control of the passenger and cannot be affected by anyone pressing the buttons in the halls. A safety button is also provided in the car, by pressing which the passenger can stop the car at any point. The elevator doors are provided with automatic latches which prevent the opening of any door from the outside unless the car is at that particular landing, and the opening of any door cuts off the current and locks the car so that it cannot be moved until the door is first entirely closed. These safety-guards reduce to a minimum the danger usually incident to the employment of an elevator in a residence, where there is no provision for some one person to be constantly in charge of the elevator.

There is also on exhibition a full line of switchboards, panel boards, etc. The special feature in this exhibit is a glass switchboard with all mountings of copper, it being the first board of this kind ever put before the public, and is only intended as a sample of workmanship and design.

This extensive and interesting exhibit is in charge of Mr. T. W. Kloman.



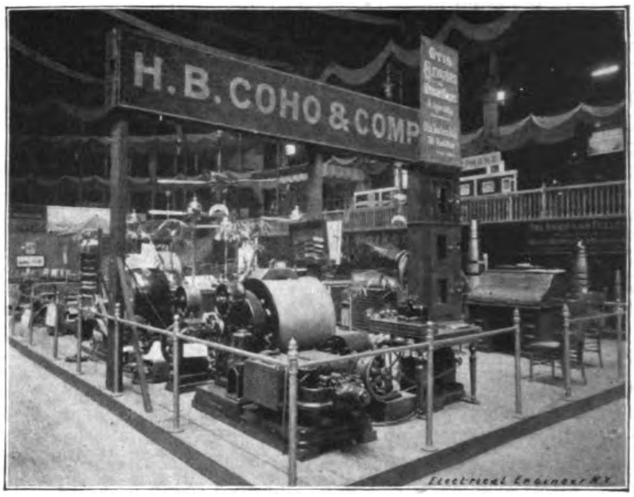


EXHIBIT OF H. B. COHO & CO. AT MADISON SQUARE GARDEN.

The Joint Exhibit of the Fostoria Incandescent Lamp Co., and the Crouse-Tremaine Carbon Co.

THE exhibits of the Fostoria Incandescent Lamp Co. and the Crouse-Tremaine Carbon Co. are located on the balcony just to the right of the main entrance. Together they make one of the most striking displays in the Garden.

On the front line of their space are six columns ranging from 6 to 10 feet in height, surrounded with diagonal lines of miniature lamps of various colors. On the top of each column is a sphere ranging from 13 to 20 inches in diameter, each covered with various shapes and colors of lamps. In all about 400 lamps are used, and the extreme brilliancy of the Fostoria lamp produces a very dazzling and beautiful effect in this novel manner.

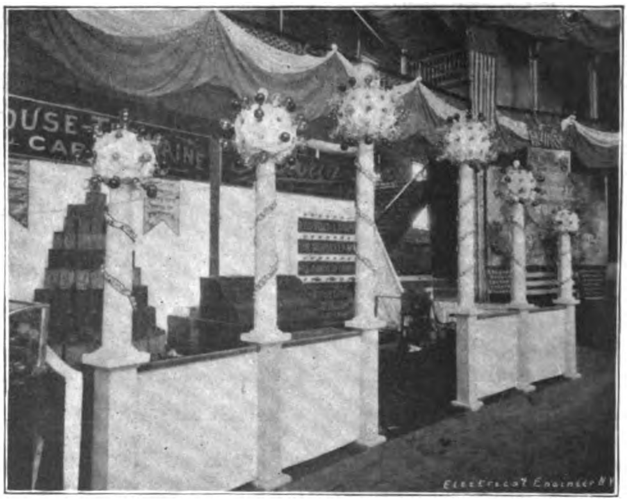
At the rear of the booth is a display rack of five circuits showing the different styles of decorative and standard lamps.

The top circuits show 200 c. p., tubular, candle flame, candelabra, lantern and conical candle lamps. The latter is a new product brought out by the Fostoria Co., and is a very beautiful decorative lamp, adapted for house and lodge hall lighting. The third circuit shows exclusively the Fostoria 220 volt lamp. By a special method of handling the filament their 220 volt lamp is in every way equal to the lower voltage lamps.

These 220 volt lamps are also shown in the conduit of the street car exhibit at the east end of the Garden, in actual service on a varying voltage.

The fourth circuit shows the "Duplex" lamp, patented and owned exclusively by the Fostoria Co. By means of a switch on the base of the "Duplex," the candle power can be doubled at will, or the life of the lamp doubled at normal candle power. This lamp has caused very great interest in the incandescent lamp field during the past year. It is made from 8 to 400 c. p.

The remaining two circuits show various sizes and styles of standard and special fancy lamps, including the pineapple, French etched, L'Empereur, engraved, frosted, street railway, and of all natural colors.



THE CROUSE-TREMAINE CARBON AND FOSTORIA INCANDESCENT LAMP EXHIBIT.

The Fostoria Co. make lamps from 3 c. p. to 400 c. p., one of the most interesting exhibits being a 3 c. p. and 400 c. p. lamp burning side by side. In fact, anything in the shape of an incandescent lamp can be seen here, and a few minutes spent in investigating their staples and novelties is well worth while.

The display of the Crouse-Tremaine Carbon Co., in connection with the lamp display, shows electric light carbons, motor and generator brushes. Several thousand carbons of various styles and sizes are formed in pyramid shape, plain and copper coated alternating.

This company, which for the past three years have supplied the carbons for lighting New York's streets, have devoted themselves to perfecting carbons for arc lighting exclusively, and are now making plain and copper carbons for series arcs, high tension cored carbons for series arcs, cored carbons for constant potential and alternating arcs, and special solid carbons for enclosed arcs.

The display of cored carbons and enclosed arc carbons is very complete. Both exhibits are in charge of Mr. H. Stillson Hart, who has represented the Fostoria Incandescent Lamp Co. and the Crouse-Tremaine Carbon Co. in the East for two years. His New York office is at 726 Broadway.

C & C Electric Co.

VISITORS to the Exhibition will find one of the most interesting exhibits to be that of the C & C Electric Co., of New York. On the main floor, near the electric fountain, they have 500 feet of floor space in which are shown a 40 kilowatt belt type multipolar generator and a 60 kilowatt belt type multipolar generator of the company's latest design, as well as a 60-inch ventilating combination, consisting of a C & C motor of the single field-coil type, directly connected to a 60-inch Blackman fan. This outfit is in operation and an interesting feature of the combination is that four speed changes are secured without the interposition of any resistance in the circuit, through the use of their "Stangland" speed commutating-switch. Four sizes of the well-known C & C bipolar machines are shown, one of them being a dynamo and one being a motor in operation.

Their line of ironclad motors and dynamos both of the open and closed types are attracting a great deal of attention. One of these ironclad motors is fitted with back-gears, mounted upon the field frame designed for a speed reduction of four to one, while another is of the inverted type, designed to go on the ceiling, and is suspended from an iron frame. The company also show in operation an 18 h. p. electric hoist, the motor therein being one of the company's open ironclad type.

A 5 kilowatt marine lighting set consisting of a Case automatic vertical engine directly connected to a C & C entirely closed ironclad dynamo is also displayed. A switchboard of the company's make also forms an attractive feature in the exhibit.

In the basement below the amphitheatre, where the operative plants are shown, may be found a C & C multipolar generator of the six pole type, developing 15 kilowatts at 170 revolutions, directly connected to a 25 h. p. Diesel "rational heat motor." and a switchboard controlling same. In the exhibit of the New York Edison Electric Illuminating Co., a 5 h. p. closed type ironclad motor of this company's make is employed; while the De La Vergne Refrigerating Company drive with one of their Hornsby-Akroyd engines a 2½ kilowatt C & C bipolar dynamo. The company is represented at the exhibition by a number of its staff.

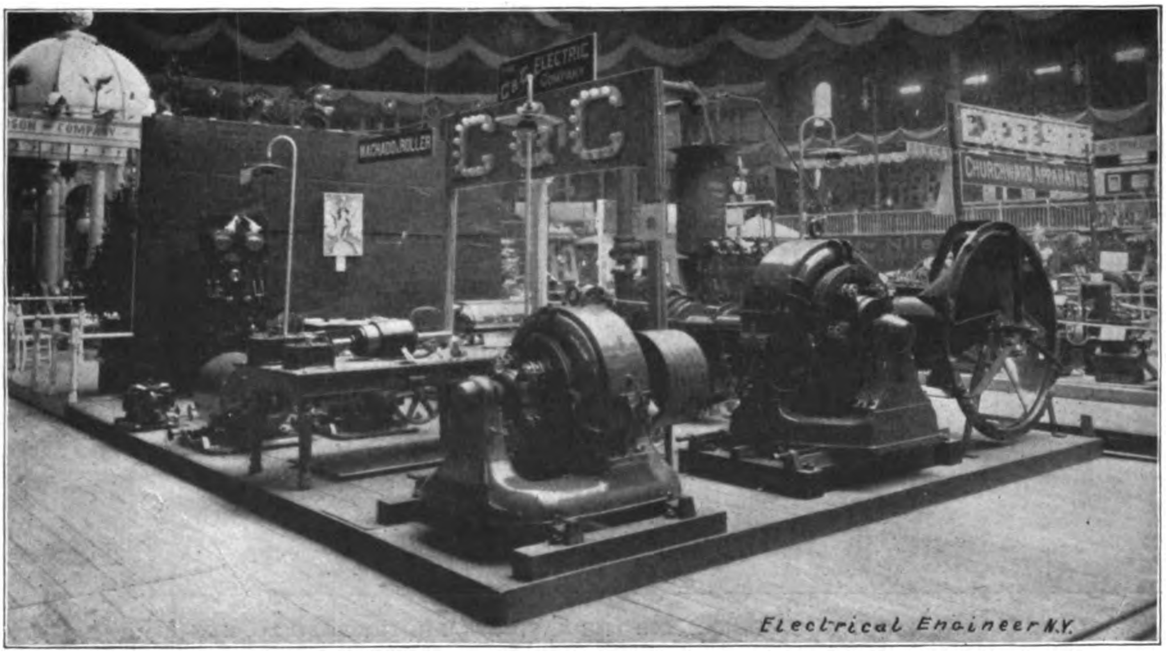


EXHIBIT OF THE C & C ELECTRIC CO. AT MADISON SQUARE GARDEN.

Silex Insulation Co.

ONE of the most tastefully arranged exhibits is that of the Silex Insulation Company, of 39 and 41 Cortlandt street, New York. A number of their smooth-bore, metal-lined, fire and waterproof insulated interior conduit tubes are arranged to represent the pipes of a church organ, and each one is capped by a miniature incandescent lamp. A very pretty experiment

THE SILEX INSULATION CO.'S EXHIBIT.

showing a current carrying heated and sagged wire inside of one of the company's tubes, which would be an impossibility in a tube not metallically lined, is performed by the attendants. This appears to be a practical and permanent elimination of the electric fire hazard. The conduit is waterproof and is made up in various shapes and any desired lengths.

Minerals and metals alone are used in the construction of the conduits. An iron or steel outer tube is separated from an inner tube of metal by finely-pulverized, densely-packed silex. This mineral, in its pure state, is acknowledged to be the most positive dielectric in the art, besides possessing exceptional heat-resisting qualities. Fusing only under the oxyhydrogen flame, it is practically indestructible.

The exhibit is in charge of Mr. F. J. Nash and J. H. Bleoo.

Juvenile Work in Electricity.

THE position that Young America is now taking in the electric and magnetic field is very clearly shown at the Electrical Show now being held at Madison Square Garden, by an exhibit of simple experimental apparatus made by young boys from the Browning School, of this city.

The models shown cover every variety of apparatus that is dear to the heart of a boy, and yet, along the whole line from push-buttons to motors, one is struck by the extreme simplicity of design and the ingenious uses made of old tin tomato cans, cracker boxes, bolts, screws, wire, and the wood that a boy can get from a soap box.

The apparatus in this exhibit was made by boys 13, 14 and 15 years of age, from designs made by Mr. Thomas M. St. John. It clearly shows that good, practical apparatus can be made from cheap materials by an average boy. The whole exhibit is wired and in working order, and it attracts the attention of a large number of parents and boys who hover around to see, in operation, the telegraph instruments, buzzers, shocking coils, current detectors, motors, etc., etc.

Mr. St. John deserves the thanks of every boy who wants to build his own electrical apparatus for amusement or for experimental purposes, as he has made the designs extremely simple, and has kept constantly in mind the fact that the average boy has but a limited supply of pocket money, an equally limited supply of tools, and is usually not overburdened with patience or persistence. He has to be lured along until he becomes genuinely interested.

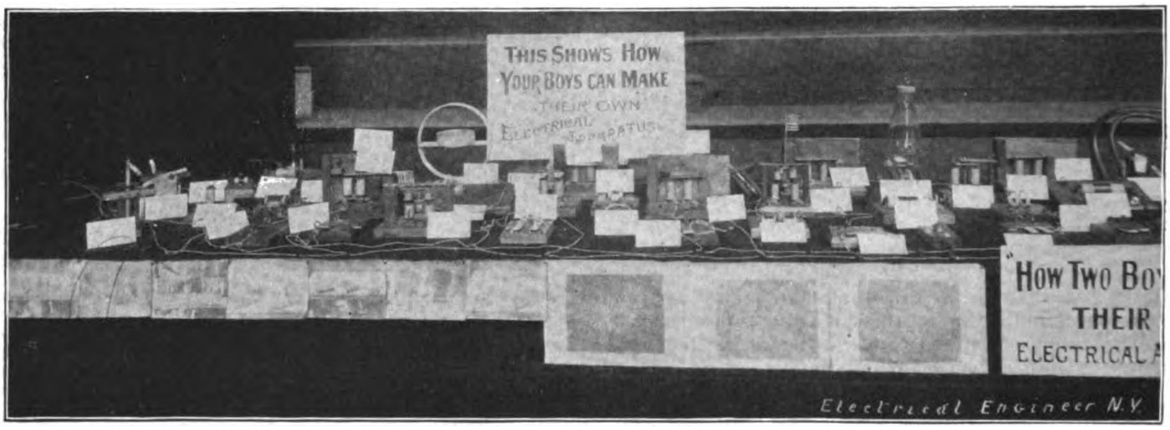


EXHIBIT OF EXPERIMENTAL ELECTRICAL APPARATUS MADE BY THE BOYS OF THE BROWNING SCHOOL, NEW YORK CITY.

Phonographic Exhibit of Edison Mfg. Co.

AS no electrical exhibition would be complete without a personal exhibit of the "Wizard of Menlo Park," or an exhibit of a company manufacturing apparatus under his inventions, there has been arranged on the main floor, to the left of the main entrance, an extensive exhibit of the numerous Edison inventions and their latest modifications. It is a joint exhibit of the Edison Manufacturing Co. and the National Phonograph Co., who are displaying a great variety of electrical apparatus in actual operation. These products alone, without the magnetic influence exercised by the sign bearing the inscription "Thomas A. Edison," attract large and interested crowds every afternoon and evening, not only to listen to the splendid phonographic reproductions, but also to inspect the numerous other novelties of which many deserve special mention. A ball-bearing motor is shown which can be used for almost any purpose where street current is not available. It can be used for fan motor work, sewing machines, jewelers' lathes, dental purposes, etc., and is noiseless, efficient and serviceable. They are all operated by the well-known Edison-Lalande cell. Another instrument which has attracted considerable attention is the cautery transformer, for medical work. This instrument can be applied to either the direct or alternating current and enables the surgeon to do cautery work, diagnostic lamp work, and supplies motive power for dental drills. There is also shown a new apparatus for the use of physicians. They can test urine, blood or sputum in a few minutes by the use of this motoric device, where it used to take hours to do so by the old

THE EDISON MANUFACTURING CO. AND THE NATIONAL PHONOGRAPH CO. EXHIBIT.

method of allowing the liquid to stand until the heavier substance dropped to the bottom of the graduate or whatever receptacle was used. Besides these apparatus the company is exhibiting X-ray tubes and induction coils, Faradic batteries, medical cabinets and appliances, fan motors, and Edison-Lalande cells.

The North American Phonograph Company are showing a new model phonograph which brings the instrument within the reach of anyone desiring it for home or society use. It is called the "standard." With it records can be made and reproduced as distinctly as with the larger and more expensive machines. A great variety of phonographs are shown and the public are entertained at all hours by famous phonographic selections, musical and otherwise. The company have placed a large number of their phonographs in the various booths, where they do useful and highly intelligent work, replacing the much abused exhibition attendant, who is more tiresome or tired and less interesting than this ideal talking machine. A number of concerts have also been arranged by the company and are in charge of the energetic representative of the companies, Mr. E. M. Smiles. The exhibit has also enjoyed the presence of Messrs. Gilmore and Gladstone, of the Edison Mfg. Companies.

Exhibit of the Electrical Engineer.

ONE thing a journal can always do at an exhibition, and that is, distribute copies of itself. At Madison Square Garden this year, however, the Engineer has done this, but has supplemented such work by many features of interest. A general view of the exhibit is shown herewith. It is situated on Newspaper Row, in the Arena Circle, on the main stairs leading to the Concert Hall and Assembly Rooms. The space is dressed with palms, and decorated with draperies, rugs, etc. It contains the usual office paraphernalia for work, and all friends of the journal are made at home. On the desk stands an Edison automatic reversing screw phonograph, driven by Chloride accumulator. The cylinder tells all about the Engineer, and as it goes on and on without attention, it saves breath and bother in

THE ELECTRICAL ENGINEER BOOTH.

a wonderful manner. The space is cooled by two Paragon fan motors, and specially lit by a very ornamental McIntire enclosed arc light. In one corner stands an Empire angle focusing searchlight, of the same type as that used in the brilliant tower illuminations, and made by the Ziegler Electric Co., of Boston. This is flashed in every direction and is intended to represent journalism as the searchlight of publicity. An interesting and beautiful model shown in the space is that of a 10-inch disappearing gun, designed by Mr. E. M. Weaver, electrician of the New York Central Railroad. In these days of war it attracts the greatest attention. There is also a splendid picture of the special electric road for the Pan-American Exposition to be held at Niagara Falls; a plan of the Exhibition power plant; one of the telephones of the Bell exchange and other features. All the staff of the journal is in regular attendance.

The Schoonmaker Exhibit of the Magnetic Field of Force.

WHENEVER a phenomenon presents itself the inquisitive characteristics of human nature seem to assert themselves. To this desire to know why, may be attributed many marvelous achievements. We all recognize that in order to arrive at satisfactory developments we must have some knowledge of the first principles involved, and in order to appreciate and understand the crystallized results of effort in any line, we must interest ourselves to the extent of becoming familiar with that which serves as a basis of operation. Perhaps in no field of science is this more true than in that of electricity, and the great progress made in the last few years serves only to emphasize the fact that great attention has been paid to a peculiar source of energy termed magnetism. Utilitarian demands have given a marked impetus to the bringing about of great results in the electrical field. The electric light has become commercial only since the creation of the dynamo; and we might enumerate many devices which have harnessed this mysterious force for the service of man. We naturally ask what is the source or

EXHIBIT OF E. T. SCHOONMAKER.

fountain head of this power? The explanation to this may be reached in some degree by observing that peculiar force already alluded to, and with which almost every one is familiar, namely the action of the magnet; this remarkable energy is described as the field of force. This field surrounds the pole of a magnet in all directions, but it is invisible, and an ocular demonstration can be rendered only by means of minute particles of iron which arrange themselves in beautiful curves about the poles of a magnet when under its influence. The experiment is performed by placing a sheet of glass or cardboard over a magnet and sprinkling iron filings on its surface. As an answer to the question how this field performs any special function in electrodynamics, we say, and show it to be true, that if a wire closed on itself be moved through these lines of force so as to cut them, we shall see that a current of electricity is at once established in the wire and continues so long as the wire is kept in motion. By increasing these lines we increase the effect. By observation we see that all dynamos are arranged on this principle, as is also the motor. The same thing applies to all electrical apparatus in which the magnet is used.

Such, in brief, is the little lecture given by Mr. E. T. Schoonmaker at his booth on the main floor of the Garden. It is not a commercial exhibit that he has, although he is willing to receive orders for his beautiful magnetic spectra; but is intended to demonstrate clearly the "field of force." On a low draped

platform rests a large sheet of plate glass, about 5 feet by 3, painted white on the under side. Beneath this is a large horse shoe form electro magnet. In the canopy overhead is a sifting box for the iron filings. When this box is gently rocked, the filings drop down softly on the glass, and as the magnet is energized the particles at once range into line around the pole caps and group in the well-known curves. When the plate is tapped, they rush inward to the central rings of filings, and these as the current is briskly thrown on and off, lie down or stand up, "like quills upon the fretful porcupine." Little motors are taken in hand and their fields shown with filings on a sheet of paper. On the tables around the booth, Mr. Schoonmaker has some of his spectra, of matchless beauty, notably those in which by the superimposition of successive plates of glass with the filings he shows the lines literally swinging out through space, or "floating." It is almost needless to add that there is no exhibit more attractive or instructive in the whole exhibition ,and Mr. Schoonmaker is to be heartily congratulated on his success.

A Dozen Exhibits by Elmer P. Morris.

MR. ELMER P. MORRIS, the well-known manufacturers' agent, has arranged in a well-located space on the gallery, the exhibit of goods manufactured by twelve leading concerns. Nearly every branch of applied electricity and the allied industries is represented here, making this one of the most interesting and instructive exhibits at the Show. The Adams-Bagnall Electric Company's display, described elsewhere, is located in this space.

The Card Electric Co., of Mansfield, O., are showing a 25 h. p. motor of the ironclad type, a 12½ kilowatt dynamo, type E: a 3 h. p. motor, type E; and over and underload automatic switches.

The Simonds Mfg. Co., of Pittsburg, Pa., exhibit 25 steel axle gears for railway motors, and 25 steel pinions.

The Keystone Electric Instrument Co., Philadelphia, are exhibiting a full line of instruments. Among the features is a slate switchboard on which are mounted a type "K" illuminated dial and a pair of type "R" instruments. In addition to the above there are shown one of their potential indicators, an arc light voltmeter and a ground detector for constant potential circuits. An excellent show is made by the company's line of portable

ELMER P. MORRIS' EXHIBIT.

instruments, represented by portable voltmeters for direct current only, and portable voltmeters for use on direct and alternating currents. Besides these, they show a pair of their type "R" instruments in practical operation on a switchboard which is used in connection with a dynamo and motor exhibition.

The Highland Electro Chemical Mfg. Co., of Cornellsville, Pa., show a full line of their well-known soldering pastes.

The Forest City Electric Works are making a display of their protected rail bonds and drop forged commutator bars. Well illustrated books on rail bonding are distributed.

The Garton-Daniels Electric Company, of Keokuk, Ia., show a full line of their lightning arresters, which are claimed to be unequalled for durability, reliability and efficiency. They are made in eleven different styles and types for both direct and alternating currents of any voltage.

The Warren Electric and Specialty Co., of Warren, O., are exhibiting a full line of incandescent lamps of all voltages and for all purposes, including miniatures and 220 volt lamps. They distribute paper flags with the significant inscription: "Remember the 'Maine' thing is a good lamp. 'Dewey' make them? We do."

The Kosmic Oil Filter Co., of Easton, Pa., are exhibiting their Kosmic oil filter, which is used for new as well as waste oil. It is claimed to save fifty per cent. on oil bills.

The Insulating Saddle Staple Co., of Brockton, Mass., are pointing out the advantages of their insulating saddle staple for bell wiring, gas lighting, telephone, fire and burglar alarm, railroad signal and telegraph work. The staples have a fibre lining under the shoulder, and can be driven hard down with a hammer without injury to the insulation.

D. J. Sinclair, of Caledonia, N. Y., exhibits automatic flexible and rigid couplings.

Mr. E. P. Morris' own exhibit consists of electric light and railway material and the Monarch insulating paint. A great deal of valuable literature is distributed at this exhibit, among which should be mentioned the useful lamp and wire chart. Mr. Morris is personally in charge of these numerous exhibits and is assisted by Messrs. C. J. Harrington, H. F. Sauville, and A. Hernandez.

Wood, Shaw & Co.'s and the Partridge Carbon Co.'s Exhibit.

A VERY interesting exhibit is that of Wood, Shaw & Co., of 40 Broad street, New York. These enterprising New York agents are making a very creditable display of the goods manufactured by the numerous firms which they represent. Among these should be specially mentioned the Partridge Carbon Co., Sandusky, Ohio, who are exhibiting motor and dynamo brushes and carbons for enclosed arc lamps. Their carbon brushes are so well known to the trade that no further mention need be made here, save that the variety and styles of brushes exhibited are marvelous, and that they are being used on some of the largest generators at the Exhibition. The company's carbons for enclosed arc lamps, however, are deserving of special note, as they

WOOD, SHAW & CO.'S EXHIBIT.

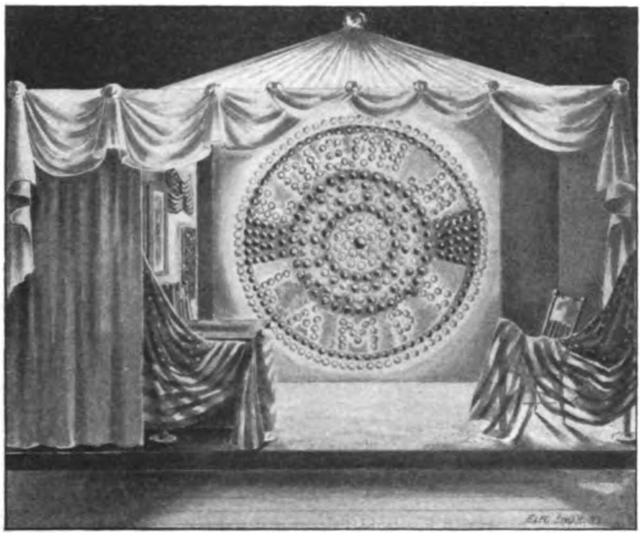
are claimed to be the first American product of this character which is in every way equal to foreign carbons. Mr. J. S. Partridge has produced these carbons, which do not deposit dust and insure a steady, brilliant light, after years of experimenting; and he is to be congratulated on his splendid success. The Nowotny Electric Company and other well known concerns are using these improved Partridge carbons and the steadiness of their lights speaks as well for the carbons employed as for the mechanisms controlling the arc.

Another exhibit in this booth is that of the O. S. Platt Mfg. Co., Bridgeport, Conn., manufacturers of the well known New England switches. These switches are models of mechanical

and electrical workmanship, and are handsome in appearance. An all copper knife switch recently placed on the market is an attraction in itself. The Universal non-arcing lightning arrester is being exhibited also in this space by the Universal Electric Co., 126 Liberty street, New York. These lightning arresters were designed for street railway, line and motor car service, and can stand continual jar and vibration. The cylindrical blocks are fastened to a slate base and placed in an iron box insulated throughout. This lightning arrester is the invention of Mr. H. M. Shaw. The Quaker City Electric Co., Philadelphia, Pa., are also exhibiting here their perfected, moderate speed ironclad type dynamos and motors. Besides the above mentioned firms, Wood, Shaw & Co. represent the Imperial Copper Brush Co., the Acme Copper Works and the Ajax Machine Works. The firm Wood, Shaw & Co. was recently organized to carry on the business of Mr. H. M. Shaw, manufacturer of dynamos and motor brushes and agent for several well known electrical firms. Mr. Wood is a practical electrical and mechanical engineer.

Lamp Exhibit of T. A. Edison, Jr.

PERHAPS the most brilliant, and one of the most handsomely arranged exhibits, is that of T. A. Edison, Jr. It is contained in a handsomely draped booth to the right of the main entrance, and consists of a bank of lamps about 8x10 feet, arranged in circles. Each circle contains a distinct type of incandescent lamp and there are ten of these circles containing an aggregate of about 900 lamps. There are 4, 8, 10, 16, 32, and 50 c. p. lamps, plain, frosted, red, blue, amber, green, and opal, spherical, tubular and the regular pear shape lamps. The con-



T. A. EDISON, JR.'S LAMP EXHIBIT.

nections are so arranged that the various parts of the bank can be lighted separately, and one part of the bank is so arranged that Mr. Edison's name appears in red spherical lamps. There is also exhibited the Edison Junior new 500 volt incandescent lamp, which is probably the only 500 volt incandescent lamp ever made with one continuous filament. The exhibit is in charge of Mr. T. A. Edison, Jr., assisted by Messrs John H. Gill, D. A. MacVean and Charles George.

The Adams-Bagnall Electric Company.

A VERY striking and complete exhibit is that of the Adams-Bagnall Electric Company, of Cleveland, O., arranged by and in charge of Mr. C. W. Phipps, the company's Eastern manager. They are exhibiting a full line of arc lamps manufactured by them, and this is probably the most complete display of arc lamps at the Exhibition. There are shown constant current series differential open arc lamps, 1,200 and 2,000 c. p., for all night service; constant current series enclosed 1,200 and 2,000 c. p.; constant potential series enclosed five in series on 550 volts and two in series on 220 volts; constant potential enclosed and marine arc lamps in single multiple on 110 volts. The standard lamp has a black japan finish and the ornamental

THE ADAMS-BAGNALL ELECTRIC CO.'S EXHIBIT.

styles are finished in royal oxidized copper, yellow brass, 17th century brass and oxidized silver.

The Prindle Pump Co.

The exhibit of the Prindle Pump Company, of 120 Liberty street, New York, is a decidedly unique and up-to-date practical demonstration of the utilization of electricity on direct connected pump work. The type of pump used is that of the Lawrence Machine Company. The general arrangement, as shown, consists of four pumps; the smallest is an automatic house pump with a capacity up to 50 gallons per minute under a suction and discharge lift of 25 feet, efficiency practically 50 per cent. The second pump has a capacity of 250 gallons per minute with 60 to 70 per cent. efficiency, designed for handling hot, cold, dirty and gritty liquids or semi-liquids.

It is erroneously supposed that centrifugal pumps are limited

THE PRINDLE PUMP CO.'S EXHIBIT.

in their economic ability to handle liquids under high heads. To show the fallacy of this idea, the third pump, with a capacity of 1,500 gallons per minute under heads up to 150 feet, is practically operated under an efficiency of 70 per cent. In the fourth pump, capacity 5,000 gallons per minute, a head of 35 feet is carried with an efficiency of 75 per cent.

This latter pump is particularly adapted for circulating, for condensers, water supply, dredging, and sewerage disposal. These pumps are built in capacities of 1 to 100,000 gallons per minute, under heads from 1 to 150 feet with the efficiencies named. They are arranged to connect directly to any standard

motor, for direct or alternating currents. All the pumps are driven by Churchward motors.

The manager, Mr. R. S. Prindle, is in nightly attendance.

Peru Electric Manufacturing Company.

A VERY tastefully arranged exhibit is that of the Peru Electric Manufacturing Co., of Peru, Indiana. They are exhibiting a full line of Peru specialties, such as high potential triple-petticoat, porcelain insulators, Peru style, and Sawyer-Man branches and mains, Edison style blocks, "Peru" multiple tablet boards, transformer fuse blocks, all sizes and styles of insulators, cleats and tubes, and Laclede and Hercules batteries. The exhibit is in charge of Mr. F. H. Schlesinger, the Eastern representative of the company.

PERU ELECTRICAL MFG. CO.'S EXHIBIT.

The Montauk Multiphase Cable Company's Working Exhibit.

AMONG the numerous attractive and very interesting exhibits, and one which is attracting considerable attention, is that of the Montauk Multiphase Cable Company, of New York. This company, whose exhibit is located in Section "S," Space 176-177, have provided a very handsome booth for the display of their remarkably unique thermo-static cables.

The company have several representatives always on duty, and continuous demonstrations are made by them to the numerous interested spectators, who may be seen at all hours about the booth viewing the demonstrations of the adaptability of the cables to all interior uses.

EXHIBIT OF THE MONTAUK MULTIPHASE CABLE COMPANY.

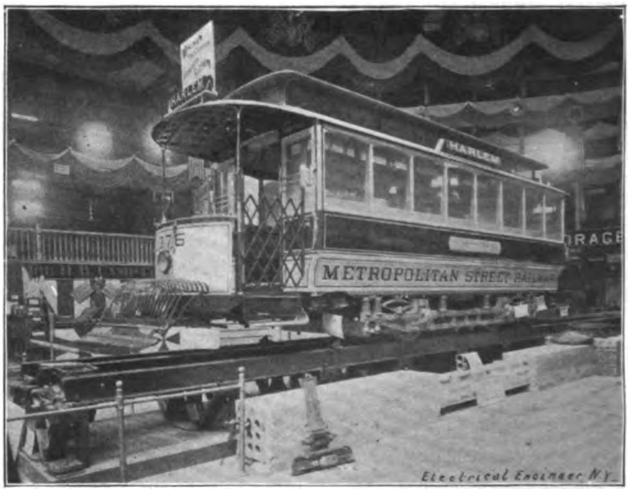
To display their exhibit, the company have provided a very handsome board resembling the side of a room, with windows, etc., upon which are placed various electric instruments, such as telephones, annunciators, call bells, etc. It is in connection with these that the various coils of thermostatic cables are placed, and when the demonstrators burn, cut or heat the cable, the effect is at once seen upon the several instruments, much to the gratification and interest of the spectators. The legitimate abuse by hammering, etc., fails to affect these cables.

The cables are installed scientifically upon the "danger lines" or in the pathway of fire. The necessary information for this is obtained from insurance statistics covering a period of twenty-five years, wherein all buildings are classified, the total number of general causes of fires given, and also percentages or "danger lines" for each particular classification.

The most important fact in connection with the cables is that they are auxiliary to all electric systems. They can be used for all interior electric purposes and obviate the necessity of installing numerous wires for specific purposes, which have no other property than the specific one for which they are installed. This makes all telephone, district service, telegraph, electric light and other wires thermo-static and thus sensitive to heat or flame and quick to give notice of any abnormal condition.

The Company's product was brought to the attention of the public on the 1st of last January, since which time the cables have been specified for various local installations and adopted by the Gamewell Auxiliary Fire Alarm Company, and also for other important channels.

The Company are giving away at their booth various kinds of literature treating upon these cables and their adaptations, diagrams of connections, installation blue prints and information generally for the trade.



STEPHENSON CAR ELECTRICALLY EQUIPPED.

Grand National Morse Telegraph Tournament at the Electrical Exhibition.

IN spite of many drawbacks, not the least of which was the absence of many skilful operators at the front, the telegraph tournament at Madison Square Garden on Saturday last was a great success, as the subjoined record will show. Had not the war intervened, enough competitors were expected to fill two days, but as it was the contest went off with great vim and dash We are indebted to Mr. J. B. Taltavall, of the "Telegraph Age," for much of the data here, his assistance in the affair being one of its most noteworthy and creditable features.

Mr. A. E. Sink, the official timer, performed his part of the programme to the satisfaction of all.

Mr. Fred Catlin, the manager of the tournament, deserves great praise for his untiring energy in the interests of all who took part in the tournament. He was very ably assisted by Mr. Thos. J. Smith, who devoted a great deal of time to the undertaking.

Phonetic records of all the senders in the championship and code classes were successfully made by the Manufacturers' and Inventors' Electric Company, of New York city, through the ingenuity of Mr. T. J. Smith. This is the first time in the

history of the craft that this feat has been accomplished. The official announcement of the results in the championship class, made by Mr. A. E. Sink, was also phonetized, and within three minutes of the closing of the contest was reproduced for the benefit of the audience, amid much appreciative applause. These Morse phonograms are all permanent in their character and can be duplicated at any time and in any number and reproduced upon any of the ordinary forms of the phonograph or graphophone. The duration of tests was five minutes.

Mr. P. J. Tierney, one of the judges, had charge of the phonetic recording, and to his vigilance the profession is indebted for the valuable phonetic records obtained.

Among those present were Thos. A. Edison, who remained during the entire evening session and was an attentive listener, A. S. Brown, J. H. Bunnell, Col. A. B. Chandler, James D. Reid, W. H. Baker, T. R. Taltavall, E. A. Leslie, C. W. Price, F. W. Jones, Wm. Maver, Jr., P. B. Delany, and many others.

THE WINNERS—AFTERNOON SESSION.

Ladies' Class—Sending. Judges: Chas. Shirley, S. F. Austin, Gardner Irving, F. F. Norton, Wm. Maver, Jr., E. W. H. Cogley, A. E. Marr and P. B. Delany. Miss J. McManus, 239 words, 8 errors, Superior Morse, first prize; Miss Emma R. Vanselow, 241 words, 8 errors, Good Morse, second prize.

230-Word Class.—Chas. F. Edney, 233 words, 1 error, Excellent Morse, first prize; F. M. McClintic, 242 words, 5 errors, good Morse, second prize. David C. Grant, who sent 225 words, was commended by the judges for his excellent Morse.

240-Word Class.—J. D. Hinnant, 252 words, 4 errors, good Morse, first prize; F. M. McClintic, 243 words, 5 errors, good Morse, second prize. Mr. David C. Grant was again praised by the judges for his excellent Morse. He transmitted 229½ words.

EVENING SESSION.

Code Class—Sending. Judges: A. E. Marr, P. T. Brady and E. H. Curlette. G. W. Conkling, 345 words, 2 errors, first prize; W. M. Gibson, 330 words, 2 errors, second prize. C. F. Edney, who sent 279 words, was complimented by the judges for his excellent Morse.

Championship Sending.—Judges: A. E. Marr, S. F. Austin, Chas. Shirley, E. W. H. Cogley and P. T. Brady. W. M. Gibson, 254 words, 1 error, perfect Morse, first prize; F. L. Catlin, 253½ words, 1 error, perfect Morse, second prize; J. D. Hinnant, 248 words, 3 errors, excellent Morse; F. M. McClintic, 243¼ words, 4 errors, good Morse; Frank English, 241½ words, 4 errors, good Morse; J. E. Kane, 215 words, 10 errors, good Morse. Mr. J. D. Hinnant received favorable mention by the judges.

Decisions in the fifty message class and the championship receiving class will not be rendered until the judges have carefully examined the work of the numerous contestants.

In the message class the fifty messages were sent by Mr. Frank L. Catlin in 32 min. 37 sec.

SOCIETY & CLUB NOTES

National Electric Light Association.

The following papers have been announced to be read at the meeting of the National Electric Light Association, at Chicago, next month: "Cost of Generation and Distribution of a Unit of Electricity;" by Calvin W. Rice. "General Distribution from Central Stations by Alternating Currents;" by Herbert A. Wagner. "General Distribution from Central Stations by Direct Currents;" by Louis A. Ferguson. "Public Lighting with Relation to Public Ownership or Control;" by Alex. Dow. "Transformer Economy;" by Winder Elwell Goldsborough.

The following "Topics for Discussion" are also announced: "Legislative Policy as to Public Service Corporations;" "Prices and Discounts for Electric Current, and Methods of Charging Customers;" "Standardizing Apparatus for Central Station Use;" "Standardizing Specifications for Incandescent Lamps;" "Freight Rates on Electrical Apparatus." Other papers and discussions will be announced later.

An evening lecture on "Electricity Direct for Coal," with lantern illustrations, will be delivered by Mr. Joseph Wetzler.

Dr S. S. Wheeler's Lecture Before the New York Electrical Society.

ONE of the best electrical lectures of recent years was that delivered by Dr. S. S. Wheeler at the Electrical Exhibition before the New York Electrical Society on "Electrically Driven Machinery," in the big Concert Hall, which, in spite of the bad weather was filled with an appreciative audience. The lecture was illustrated by about 100 slides showing a variety of direct motor applications, and on the stage was a collection of interesting apparatus for experimental demonstration. Dr. Wheeler said:

In being called upon to speak, after an interval of a number of years, upon a subject in which I have always been deeply interested, and of which I have been a strong advocate, it is a great pleasure to find in its remarkable progress that my claims and expectations have been more than realized. It is a common saying, that electricity has made wonderful strides within the last few years, and I think I need have no hesitation in saying that it is in that department of practical electrical work, covered by the subject of this evening, that the greater part of this conspicuous advance has been made. A few years ago, any suggestion of driving machinery by electric power was received with doubt as to its success; to-day electric driving is universally acknowledged to be by far the best method, for a number of reasons, and the developing of this new industry has furnished work to keep the electrical factories busy through the past several years of hard times. The savings in the operating expense of factories have been found to be so great that mill owners have purchased electrical equipments in the hardest times, as a measure of economy.

To what is this great success due. It is evident, from the rapidity with which electric motors have been introduced, that their advantages must be very marked.

First, they are capable of direct-connection to the machinery to be operated, which means that their power, however great it may be and however large the machine, can be transmitted by the shaft instead of requiring a cumbersome belt and a pulley on the driven machine large enough to receive, by the friction of the belt traveling upon it, the needed power. As 1,000 feet of belting one inch wide must pass around a pulley in a minute to transmit one h. p., it is evident that the handling of 100 h. p. will require a large pulley and a heavy belt, which is not only inconvenient and sometimes dangerous, but occupies considerable floor space and requires that the machine be heavy enough in design to support the large pulley and the strain of the belt.

Second, motors are capable of regulation and control of their speed and driving power with great convenience, so that electrically driven machines can be started, stopped, reversed or speeded-up by the use of small instruments known generally as "regulators," which may be placed close to the machine, or in any other convenient location; while machinery driven by belting can be merely started or stopped, and then only with a considerable manual effort in shifting the belt, or can be run at other speeds only by bodily removing the belt to a driving pulley of different size.

Third, motors, when used for driving machinery, are usually attached directly to the machine, and being much less bulky than other means of driving, the entire machine is independent of any line-shafting, and therefore may be located in a convenient position without regard to this limitation, and in many cases can even be picked up and shifted from one place to another, as the exigencies of its work require.

Fourth, electricity permits the saving of ½ to ⅔ the power otherwise required. This results from the fact that when the tool is stopped the motor is stopped and draws no power, whereas, in belt-driving, when the tool is stopped the belt or one of the belts is simply shifted and continues to run on an idle pulley.

And last, electricity presents an enormous advantage in the transmission of power. This subject is so large, and has been so well discussed, that I will not attempt to add anything to it here, but will give one or two experimental illustrations of what I have already stated. (Dr. Wheeler here showed a little portable grindstone.)

Another illustration is in the use of a motor for operating a lathe. A belt-driven lathe must have a line shaft attached to the ceiling, and the ceiling usually has to be strengthened to support this shaft. It must then be carefully made parallel with

this shaft by plumb line and instruments, and then be securely bolted to the floor. A belt of sufficient width to give the necessary friction must be provided, and if the lathe is to be reversed, a second belt, crossed, must be added. The size of the driving pulleys on the shaft on the ceiling must be carefully determined with reference to the pulleys on the lathe, to give the desired speed, and then the lathe may be operated provided the line shaft is kept in motion by a steam engine somewhere. But the lathe cannot be moved.

If the same lathe is provided with an electric motor for driving it, the power may be supplied from any circuit through an ordinary lamp cord, and the lathe may be used in any position. I have here a small engine lathe with a motor built directly on its spindle. The lathe is suspended so as to be swung around in any direction, and will operate continuously while so handled. (Dr. Wheeler then showed the lathe in operation.)

I have one other crude experiment, intended to give an idea of what may be done with an electric drill press, which I will show after describing some views of machinery. The gradual introduction of electric motor driving on machinery has, of course, led to such modifications in the design of machinery as would naturally follow from the differences between belting and motors. I mean, for example, that since the motor is small and can be built into the machine close to the cutting tool or the part which uses the power, that all shafts, gearing, wheels, etc., within the tool, which have been heretofore necessary to receive the driving belt and transmit its power to the tool, may be dispensed with, and then the frame of the machine may be made a different shape, or much lighter, since it does not have these additional parts to support. The attitude of the manufacturers of machinery, during the last five years, who are of course conservative and not stimulated by the interest and confidence in the future of electricity that the electrical men felt, has been interesting. At first they said they supposed their machines could be operated by a motor if the thing would run, and that the purchasers of their machines might try it, but they would take no responsibility. Then they gradually became willing to furnish their machines with brackets and other parts for the ready reception of the driving motor, and now they are anxious to cultivate the electrical trade and to co-operate with its members in bringing out simplified designs of machines with motors incorporated.

I shall have the pleasure now of showing you a number of views of machines combined with motors, some of which are of machines especially modified in their construction in view of the new method of driving. The description of these will be necessarily somewhat disconnected. (Dr. Wheeler here showed the slides, including some of the U. S. Government Printing Office, where the "Maine" report of 300 pages was put through in a night and laid on the desks of the Congressmen in the morning.)

I will now show a crude experiment in further illustration of the extreme portability of electric tools, and at the same time illustrate the method now actually in use in the ship-yards for attaching drills and other tools to the sides of ships. (Dr. Wheeler here showed a drill with magnet which froze or glued to the plate and at once began drilling.)

In conclusion, I can think of no stronger or more flattering evidence of the success of electric power as a new industry than the fact that large quantities of American apparatus are now being installed on American plans and according to American methods in other countries, and there are to my knowledge alone, at the present time in this country, half a dozen engineering representatives of English manufacturers, studying what we have done, and finally leaving orders with us. So that those of us who are not wanted in more aggressive fields of operation at the present time, are at least able to contribute for our country an industrial victory.

New York Electrical Society.

The second lecture of the Society's Exhibition Series will be given in the Concert Hall, Madison Square Garden, on Thursday, May 19, at 8:30 p. m. Professor I. Fujioka, of the Imperial University, Tokyo, Japan, will lecture on "Electricity in Tokyo and the Kingdom of Japan."

A. T. THOMPSON & CO., 26 Bromfield street, Boston, Mass., have prepared a series of stereopticon slides illustrating Cuba and the war.

American Institute of Electrical Engineers.

The 15th annual business meeting of the Institute will be held at 12 West 31st street, New York City, on Tuesday, May 17, 1898, at 8 o'clock p. m. The annual report of Council will be presented, including the financial statements of the treasurer and secretary. The annual election of officers will also be held. Matters pertaining to the business affairs of the Institute will be brought up.

The next meeting, the 15th general meeting, will be held at Omaha, Neb., June, 27-29, 1898.

Colorado Scientific Society.

A very interesting lecture on "Gas and Oil Engines" was delivered by Thos. L. Wilkinson before the Colorado Scientific Society, in Denver, on March 5, 1898. The lecture, which is an exhaustive treatise on the above subject, has been published by the society in the form of a well illustrated pamphlet.

LEGAL NOTES

The Edison Patent for Compound Dynamo Winding Declared Void.—Edison Electric Light Co. vs. E. G. Bernard Co., et al.

Judge Coxe, of the United States Circuit Court for the Northern District of New York has rendered a decision in the suit of Edison Electric Light Company vs. E. G. Bernard Company, et al., upon the Edison patent No. 264,668, for the compound winding of a dynamo, dismissing the complaint.

The Edison patent is declared to be invalidated by the patent to Charles F. Brush, No. 217,677, granted to Mr. Brush for this same improvement some three years prior to Edison's patent. Judge Coxe in his opinion says that the old Brush dynamos of 1878, built in accordance with his specifications, tested during the trial, showed completely satisfactory automatic regulation from no load to full load when running incandescent lamps of low voltage, such as are used at the present day in large cities for telephone exchange signals where they are operated by compound wound dynamos in all essential respects like the Brush compound wound dynamos of 1878-9. In fact, the Brush dynamos of twenty years ago can be put into operation where a modern compound wound dynamo is used, without any modification or change whatever, so that if the Edison patent were sustained, it would involve the enjoining of the use of dynamos built for the same purpose as that set forth in the Edison patent No. 264,668, and built four years before the date of his application.

As to the contention of the plaintiff that the Edison patent referred particularly to the application of the compound wound dynamo for feeding electric lamps, Judge Coxe says:

"To restrict the Brush patent to electroplating would be as unfair as to restrict Edison's to electric lighting. The one illustrates his dynamo in connection with the first named translating devices, and the other with the second named devices. As before stated the patent cannot be limited to any one multiple-arc system of electrical distribution, but if it could be, invention is not involved in changing one series of translating devices for another.

"It seems probable that, if this controversy related to any other machine for generating and regulating power, contention would cease the moment a device was discovered in the prior art as near to the patented machine as Brush is to Edison. The mystery and uncertainty which surrounds everything relating to electricity and the feeling of admiration, almost akin to reverence, for those men who have subdued this unknown and dangerous force and made it do the world's work, makes the Court diffident about applying those principles which are axiomatic in patent law. There is always the apprehension that injustice may be done through failure to comprehend the abstruse and difficult problems presented. This fear has been augmented in the present instance, and the difficulties of understanding the problems involved have been vastly increased by a record into which has been dumped haphazard everything which either party believed had a bearing not only upon the point in issue, but upon the

general subject of electrical distribution. But even were there more doubt as to the correctness of the conclusion reached the Court should still hesitate to enforce a patent in the sixteenth year of its age, and thus lay the entire art under tribute, when the public has had a right to assume that such a system as the defendants are using would not be molested.

"The bill is dismissed."

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued May 10, 1898.

Alarms and Signals:—

ALARM. I. B. Frazee, Blairstown, Iowa, 603,898. Filed March 6, 1897. Employs an electrical circuit adapted to be broken by entrance to the building, whereby electromagnetic mechanism will be released to throw into operation a bell or other alarm.

Batteries, Secondary:—

PRIMARY ELEMENT WITH REGENERABLE NEGATIVE ELECTRODE. O. E. R. Von Burgwall and L. Offenschussel, Vienna, Austria-Hungary, 603,890. Filed Dec. 9, 1896. Consists in first preparing a peroxid plate of porous peroxid of lead on a lead frame, then freeing this plate of air and moisture, then impregnating the peroxid with a water soluble concentrated electrolyte, and then partially drying the electrodes so that they present dry surfaces.

Conductors, Conduits and Insulators:—

CONDUIT WIRING MACHINE. W. E. Cowan, Brooklyn, N. Y., 603,623. Filed Aug. 27, 1897. Consists of a guide-section having runners thereon, a rope-carrier, a rod carrying the guide and carrier respectively, and means whereby the guide and carrier may be forced alternately within a conduit.

CONDUITS FOR RAILROADS. F. S. Pearson, Boston, Mass., 603,656. Filed Sept. 14, 1897. Embodies a trap in the top of the conduit; mechanism by which the trap is opened and closed, and an actuator arranged to be depressed by the car wheel, whereby the trap mechanism is operated.

UNDERGROUND CONDUIT FOR ELECTRIC CONDUCTORS. C. H. Sewall, Chicago, Ill., 603,745. Filed May 8, 1895. Composed of sections of pipes joined end to end and laid in multiple to form a group of ducts.

CABLE STRINGER. F. A. Cannon, Denver, Col., 603,991. Filed Dec. 3, 1897. Comprises means for supporting the cable and suspension wire, a bracket detachably applied to means, a roller journaled in the bracket and adapted to engage the cable during the operation of stringing, and means located adjacent to the roller for supporting the suspension wire.

Dynamos and Motors:—

DYNAMO OR MOTOR. F. Schwedtmann, St. Louis, Mo., 603,709. Filed Oct. 23, 1897. Comprises a casing for the field magnet core cast in one piece, a base formed integral with the casing, a laminated field magnet core inserted in the casing from the bottom and means for rigidly securing the core in the casing.

Electro-Metallurgy:—

APPARATUS FOR EXTRACTING PRECIOUS METALS. J. R. Hebaus, Butte, Mont., 603,904. Filed May 21, 1897. Comprises a tank having an amalgamated copper lining forming a cathode and a multiplicity of agitators each rotating on its own axis and at the same time traveling around the tank, the agitators forming an anode.

Electro-Therapeutics:—

ELECTRO-THERAPEUTIC APPARATUS. G. G. Duke, Chicago, Ill., 603,815. Filed Dec. 6, 1897. Comprises an open-ended casing provided adjacent to its open end with a perforated diaphragm with an inlet-tube opening into the receptacle behind the diaphragm and with an outlet tube leading therefrom between the diaphragm and the outer margin of the casing.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. F. A. Gilbert, Brookline, and E. O. Lundin, Beachmont, Mass., 603,630. Filed July 1, 1897. Enclosed arc lamp having means for holding the carbon in place while removing the inner globe for trimming.

ELECTRIC ARC LAMP. J. H. J. Haines, New York, 603,687. Filed May 27, 1897. Comprises an annular base plate, an outer globe supported thereon, a removable ring for sustaining the globe, an arc inclosing chamber mounted directly upon the plate over an opening therein, and a removable plate closing the opening and carrying the lower carbon holder.

ELECTRIC INCANDESCENT LAMP. W. J. Phelps, Chicago, Ill., 603,705. Filed Sept. 7, 1897. Comprises a vacuum bulb, two sections of incandescent material, one of the sections serving as a resistance to modify the current for the other section.

ELECTRIC LANTERN. F. G. W. J. Adams, London, England, 603,882. Filed April 24, 1897. Details of construction.

SAFETY INCANDESCENT ELECTRIC LAMP. F. G. W. J. Adams, London, England, 603,883. Filed May 10, 1897. A safety lamp consisting of the lamp proper which is provided with a glass chamber inclosing the lamp and joined thereto by the fusion of the glass, and an automatic circuit breaker becoming active upon breakage of the inclosing chamber.

Miscellaneous:—

AUTOMATIC ELECTRIC FEED-WATER REGULATOR. A. E. Maccoun and J. Noey, Braddock, Pa., 603,650. Filed Dec. 3, 1897. Details of construction.

CONTROL APPARATUS FOR ELEVATORS. A. Sundt, New York, 603,665. Filed April 24, 1897. Combines with the motor and working circuit, local circuits operated from the car or floor, and a non-interfering locking device operated by a local circuit and released by the motor.

ELECTRIC CONDENSER. C. S. Bradley, Avon, N. Y., 603,722. Filed July 29, 1897. An electric condenser having as a dielectric, stearate of lead.

ELECTRICAL APPARATUS FOR SCHOOLS. M. E. Crowell, Indianapolis, Ind., 603,875. Filed Nov. 23, 1896. Apparatus for demonstrating the nature and means for generating and utilizing electricity.

ELECTRICAL STEERING APPARATUS. H. O. F. Bindemann, Madrid, Spain, 603,886. Filed June 4, 1897. Details of construction.

Railways and Appliances:—

ELECTRIC RAILWAY. E. C. Crocker, Bridgeport, Conn., 603,624. Filed Sept. 17, 1897. Surface contact system.

ELECTRIC RAILWAY. E. C. Crocker and E. C. Howe, Bridgeport, Conn., 603,625. Filed Sept. 17, 1897. Sectional third-rail system—details of construction.

TROLLEY DEVICE FOR ELECTRIC RAILWAY CARS. L. E. Walkins, Springfield, Mass., 603,672. Filed April 14, 1897. Details of construction.

ELECTRIC HEADLIGHT. F. W. Dressel, New York, 603,876. Filed Oct. 6, 1897. Comprises a flanged ring for securing within a car dash the ring carrying the lamp bracket and lamp; a glass secured within the ring, and the body of the headlight hinged to the fixed ring and arranged to swing inward.

RAIL JOINT. J. Wayland, Newark, N. J., 603,779. Filed Jan. 22, 1898. Comprises a bed-plate and an insulating-shim of substantially the length of the floor of the bed-plate having metal blocks therein at a point between its ends.

Regulation:—

STARTING DEVICE. J. P. Stone, Schenectady, N. Y., and S. E. Doane, Marlborough, Mass., 603,778. Filed Oct. 22, 1897. A starting device for single-phase alternating current motor, comprising two-phase displacing devices in series across the mains, and in shunt to the motor.

Switches, Cut-Outs, Etc.:—

ELECTRICALLY-CONTROLLED SWITCH. E. M. Hewlett, Schenectady, N. Y., 603,786. Filed Jan. 23, 1897. Employed for establishing or interrupting the circuit connections of a system of distribution or electrical apparatus located at a distance from the point of control.

SWITCH FOR ELECTRIC MOTORS. F. E. Herdman, Winnetka, Ill., 603,849. Filed Jan. 9, 1897. Details of construction.

Telephones:—

THROW-OFF SWITCH FOR TELEPHONES. N. Fallak, San Francisco, Cal., 603,681. Filed Aug. 17, 1897. Automatic switch for telephones in interior systems.

THE STOCK MARKET

A Tendency Toward Higher Prices.

There are many reasons for higher prices on the stock market. Among these are the development of Spain's weakness and interior dissensions, the prestige given America by the sweeping victory at Manila, the extraordinarily high prices for our farm products, the large trade balance in our favor, the heavy earnings of various railroad systems, and the general buoyancy of all industries, despite the strain of war. Spanish 4 per cent. bonds have even fallen below 30, while our own 4's are strong around 120, and the premium on gold in Madrid has reached 114. Few people in America wanted the war, but all were determined to stop the atrocities in Cuba, at any cost. Even now it begins to look as though this disinterested resolve brings with it solid rewards, such as the Philippine Islands as our key to the not-too-open door of Eastern trade.

During the week 21,856 shares of Western Union were sold, up to 89¼. Of General Electric, 21,105 shares were sold, up to 36¼. In Boston, American Bell Telephone reached 261. New York Edison was up to 126.

REPORTS OF COMPANIES

General Electric Co.'s Annual Meeting.

At the annual meeting of the stockholders of the General Electric Company, which was held at Schenectady last week, 210,000 shares were represented. The following directors were elected: Gordon Abbott, Boston; Oliver Ames, Boston; C. A. Coffin, New York; T. Jefferson Coolidge, Jr., Boston; C. H. Coster, New York; Thomas A. Edison, Orange, N. J.; George P. Gardner, Boston; Eugene Griffin, Ardsley, Castno; F. S. Hastings, New York; Henry L. Higginson, Boston; J. Pierpont Morgan, New York; Robert Treat Paine, 2d, Boston; and George Foster Peabody, of New York.

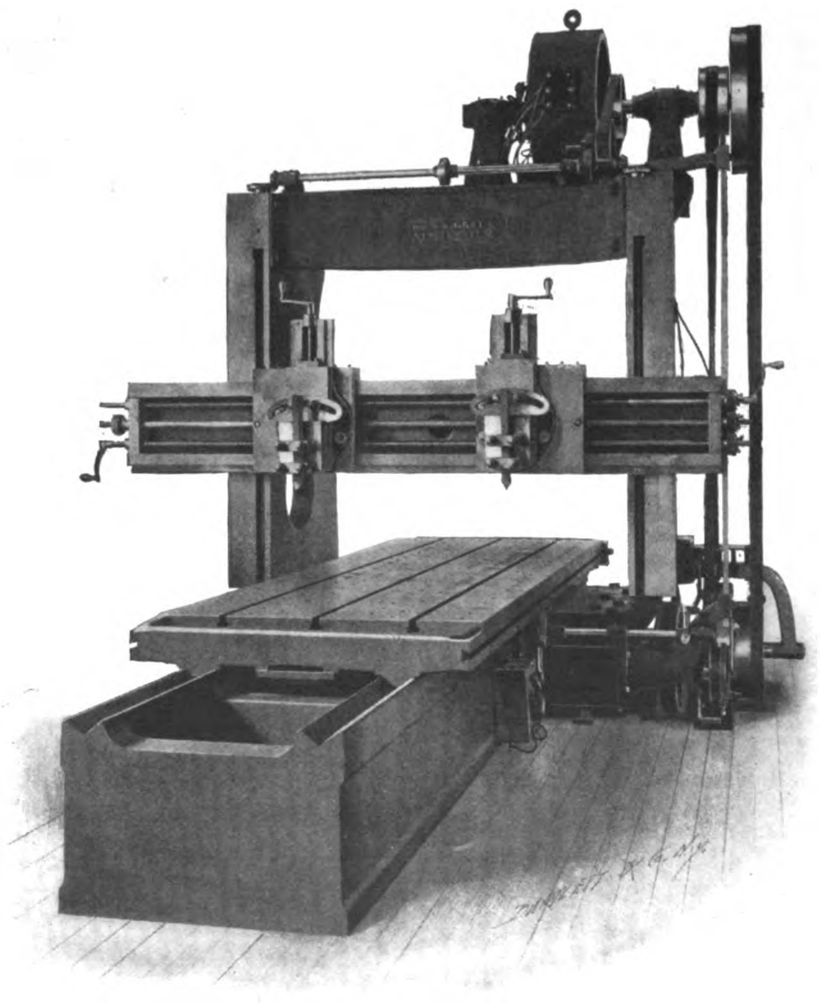
The following resolution was adopted: "Resolved, That the interests of the stockholders require that any proper or necessary adjustment of the impairment of the copital of the company should be promptly made, with a view to the early resumption of dividends."

It seemed to be the general opinion among the directors that the proper adjustment would be to scale the stock by one-half, and such a scheme will be presented to the stockholders for their consideration in the near future.

TRADE NOTES & NOVELTIES

Planer Driven by Bullock Motor.

THE Bullock Electric Mfg. Co. have lately issued a small card which they enclose in all letters to machine builders and factory owners. On one side of the card is displayed the illustration shown herewith of one of their motors operating a 72" Gray planer. The shaft of the motor is coupled direct to the main driving shaft of the planer. The motor is of small size and is placed on top of the tool, allowing a traveling crane to pass over it. The motor is shunt wound to give constant speed under varying loads, and has a capacity of 12 h. p.



PLANER DRIVEN BY BULLOCK MOTOR.

On the other side of the card is a short description of the arrangement of motors on machine tools and the advantages to be derived from this mode of supplying power. The card is printed in two colors and makes a neat enclosure for letters.

THE C & C ELECTRIC CO., 143 Liberty street, New York, report satisfactory sales of their engine type generators.

The "Standard" Acetylene Gas Burner.

One of the greatest obstacles in the way of the introduction of acetylene gas as an illuminant has been the difficulty in obtaining a suitable burner at a reasonable price. Several kinds of burners have been put on the market and some have worked fairly well, but none have given entire satisfaction. However, after years of study and experlment there has been invented a burner which may truly be called the "acme" of success.

This burner is the invention of Col. D. M. Steward, who is well known to the gas trade of the United States as the President of the D. M. Steward Manufacturing Company, of Cincinnati, and later of Chattanooga, Tenn., manufacturers of lava gas tips and gas burners of all descriptions. Col. Steward is also the inventor and patentee of the well-known lava electric insulators which are now in use by some of the largest electrical companies in the world.

Some of the strong points of this burner are: Its capacity—it burns from one-eighth to five or ten feet or upwards per hour. Its entire novelty—it is different in construction and appearance from any other burner on the market. Its strength and durability—it is not a hollow shell, but a solid and substantial piece of lava that needs no care whatever in handling. It is positively non-smoking and non-carbonizing; and finally, it does not infringe anybody's patents. The State Line Talc Co., of Chattanooga, Tenn., who manufacture the burner, are prepared now to handle orders for a limited amount only. Their plant is being rapidly extended, and they will very soon be prepared to meet all demands promptly. A sample will be sent, registered, postage paid, to any point in the United States or Canada upon receipt of 50 cents, P. O. Order.

THE K. McLENNON CO., manufacturers of Gale's Commutator Compound, have moved to 100 Washington street, Chicago, Ill.

Addition to the Carnegie Plant.

The power plant of the Carnegie Steel Company's Edgar-Thomson Mill is to be enlarged by the addition of apparatus from the Westinghouse Electric and Manufacturing Company. The new generator is to be the Westinghouse standard 800 k. w., 250 volt, 85 r. p. m. engine type machine. It will be direct connected to a vertical Allis-Corliss engine, and will operate in multiple with two 400 k. w. Westinghouse generators already installed. The present switchboard is to be enlarged by the addition of a new generator panel, to provide for the operation of the new machinery.

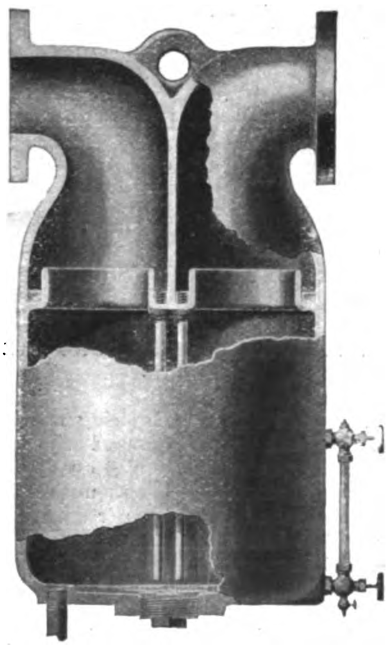
The Hoppes Steam Separators.

The Hoppes Mfg. Co., of Springfield, Ohio, well known as the manufacturers of the Hoppes live steam feed water purifier and exhaust steam feed water heater, have placed upon the market a new separator, having some new points of interest. As shown in the accompanying cuts these separators are made for either vertical or horizontal pipes, but the principle employed in each is essentially the same.

The object of the designer of this separator has been to secure as great efficiency as possible in the separation of the entrained water from the steam with the least possible obstruction to the flow. With this object in view an effort has been to keep the interior of the separator as smooth as possible, and all sharp corners or depending ledges have been avoided, as these not only add friction, but, worst of all, the entrainment would be blown from them by the force of the current sprayed into the steam and add saturation.

As will be seen the steam inlet gradually enlarges into a steam chamber of ten times the area of the pipe, and is then gradually reduced to the original area. No baffle plates or other obstructions are employed, and the steam is not required to take on any centrifugal, zigzag or other tortuous motions in its passages through the separator.

The principal feature of the separator, however, is the interception of the entrainment by gutters which are kept partially filled with water. It has been found that by keeping these gutters or channels thus partially filled all the entrained water or oil is effectually cut off, the channels being arranged to guard both

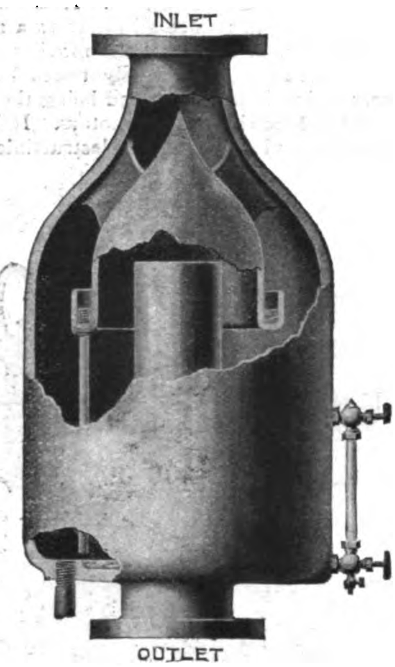


HOPPES STEAM SEPARATOR AND OIL ELIMINATOR—HORIZONTAL TYPE.

the inlet and outlet of the separator. The excess entrainment caught by the gutters is carried to the bottom of the separators by a small pipe or pipes, as shown in the engraving.

In the vertical separator the steam enters at the top, and all the entrainment following the interior surface will pass along the surface to the bottom of the separator and be intercepted by the water at the bottom. The water or oil in the steam which is not following the surface will strike the exterior of the cone in the top and spreading over its surface will be caught by the gutter at the bottom of the cone and be carried to the bottom of the separator by a small pipe provided for that purpose.

In the horizontal separators the steam may enter at either side, both being alike. As the steam enters it passes one of the gutters and as it ascends on the other side it passes the other. All entrainment is caught by the gutters and carried to the bottom of the separator from which it is trapped in the usual manner.



HOPPES STEAM SEPARATOR AND OIL ELIMINATOR—VERTICAL TYPE.

This company also manufactures separators and receivers of large dimensions built on the same plan of the separator. They also manufacture oil eliminators and grease extractors for exhaust steam. All separators for pipes above 8" are made from flange steel, as are also the combined separators and receivers. A new illustrated catalogue of these separators is in press and about ready for distribution.

New Slow Speed G. E. Motors.

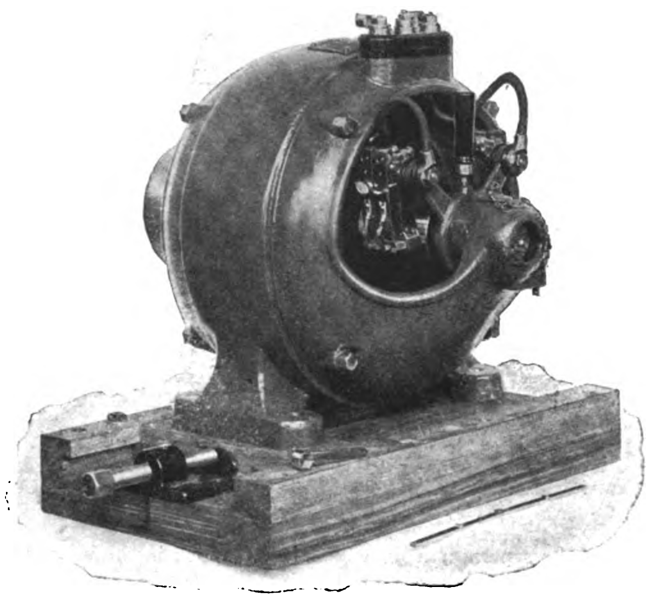
IN redesigning its line of motors to run at slow and moderate speed, the General Electric Company has endeavored to embody in them, such improvements as have been dictated by past experience with, and careful observation of, the operation under actual commercial working conditions, of its preceding types. The result is that the motors of the present type are for their output, perhaps, the lightest and most compact built.

For all powers up to and including 5 h.p. in the slow speed and 8 h. p. in the moderate speed, the motors are bipolar ironclad; up to and including 95 h. p. the four-pole type is standard. The latter method of construction has been adopted on account of its many manifest advantages, viz., shorter magnetic circuits with consequent reduced exciting current; greater output and higher efficiency for given weight and speed; economical distribution of magnetic material and minimum of floor space.

The frames are iron of the highest quality and the poles pieces of special soft steel. The latter being readily removable, the field coils may be taken off and changed without disturbance of either frame or armature and the frame itself being divided horizontally affords easy access to the armature. The pillow blocks of the four-pole machines are cast with the bed plate and the lower part of the machine, thus insuring perfect centering of the armature. The bearings are all self-aligning, self-oiling and of ample size.

The armature core is built up of laminations slotted to receive the coils which, lying below the outer surface of the core, are protected from mechanical strain or abrasion. The spider carrying the core is prolonged at each end in two flanges, upon which the ends of the coils lie without being bent. This is the General Electric cylindrical winding by which a large radiating

surface is given the armature conductors, the length of wire is reduced to a minimum, reducing armature resistance losses and increasing the efficiency of the motor, the coils may be readily removed and replaced, and being imbedded in the slots neither move nor vibrate. The core itself is provided with ventilating ducts through which the air is drawn to circulate throughout and cool the entire armature structure. The low running temperature of these motors is exceptional. It is obtained by so designing all the parts as to reduce all losses to a minimum and giving a free circulation of air to all the moving parts. The coils are made on forms and separately tested before application to the core, the insulation employed being the same as that used in the General Electric railway motors. It is tough, impervious to moisture and practically indestructible, even under



NEW SLOW SPEED G. E. MOTOR.

heavy overloads or by lightning. The commutator segments are of hard drawn copper, supported on a separate spider and the connections between them and the armature coils are carefully made to prevent the possibility of open circuiting.

The brush holders have a solid casting connecting the brush box with the stud and an adjustable pressure spring, giving an even pressure and firm and accurate contact of the carbon brushes upon the commutator—an important factor in securing sparkless and noiseless operation. Change from no load to overload can be made without changing the brushes and without sparking.

The motors ranging from 1 h. p. to 5 h. p. in the slow speeds, and from 1¾ h. p. to 8 h. p. in the moderate speeds, are bipolar, the projecting field effectually protecting the spools and armature from injury. Stability is secured by giving to these machines a centre of gravity very low.

The slow speeds of the four-pole type adapt them especially to all factory, mill and shop requirements. They may be belted directly to ordinary slow speed line shafting without intermediate counter shafting. The bipolar type are adapted to the driving of lathes, printing presses, fans, drills, pumps and, indeed, to almost any power work where small units of power are required and little space available. They are arranged to run in any position, whether suspended from the ceiling, attached to a wall or set upon the floor.

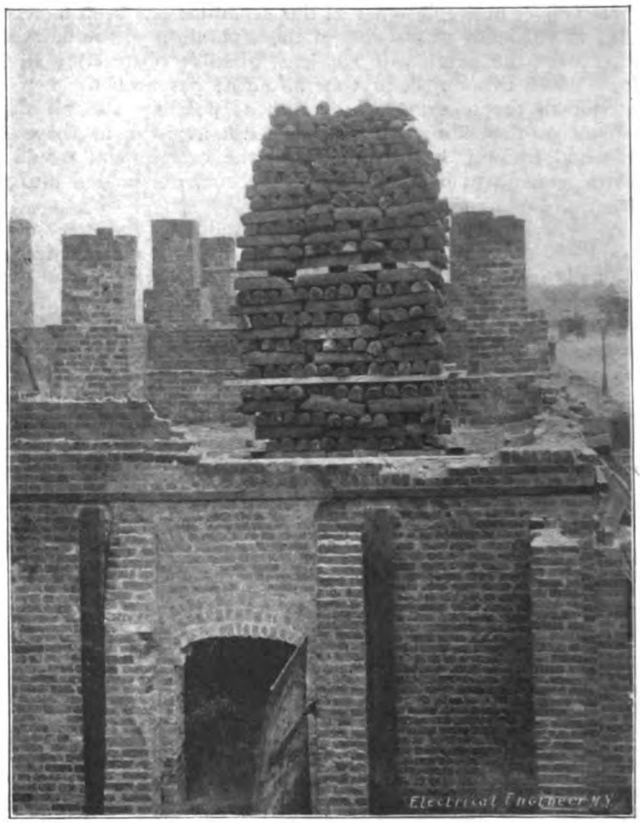
A Warning to the Trade.

The Warren Electric and Specialty Co. inform us that unauthorized parties are offering a lamp to the trade labeled "Warren." The Warren Company suggest the name "Cuckoo" be adopted by the interloping parties, as better adapted to the character of their dealings. The genuine Warren lamps are labeled "The Warren Electric and Specialty Co., Warren, Ohio," and the company issues a caution to purchasers to look out for the label.

Expanded Metal Concrete Fireproof Floors.

SOME very interesting work in fireproofing, specially adapted to power houses and central stations, has recently been done throughout the country by the Manhattan Concrete Company, of No. 156 Fifth avenue, New York. It is perhaps best exemplified in the floor arches built for the plant of the New York Sugar Refining Company. These arches are known as expanded metal concrete floors, and consist of concrete slabs about four inches thick and weighing about forty pounds per square foot, re-enforced along the lower section by a webbing of expanded metal. Due to this metal, the strength of the combined slab is multiplied ten times, while the weight is but very slightly increased.

The New York Building Department made a test of these floors by first placing a distributed load of 150 pounds to the square foot upon them, and then starting a fire under them, which was continued for five hours, the maximum temperature being 2150 degrees Fahr. At the end of this time, a stream from a fire engine was turned on until they were cooled.



TEST OF AN EXPANDED METAL CONCRETE FIREPROOF FLOOR.

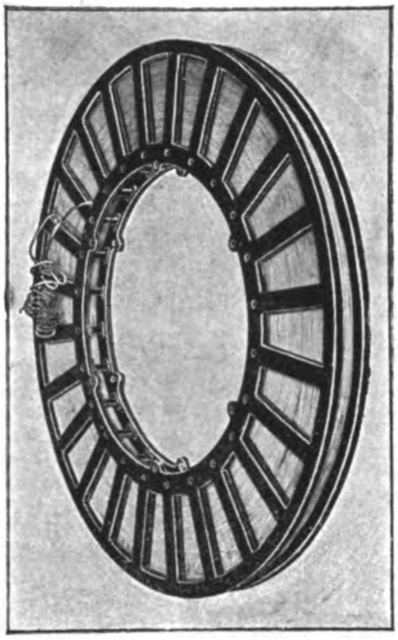
Subsequently a slab of this same flooring was cut through, isolated from the rest, and was then loaded with 32,025 lbs. of pig-iron (Building Department's weighing) on 14 square feet. Further loading was impracticable, but as no break or change occurred under this load of 2,287 lbs. per square foot, it was evident that the arches had not been injured by the fire test described above. The accompanying engraving shows the application of the pig-iron load to the isolated section of floor mentioned above.

Another weight test of expanded metal concrete floors was recently made in the new Stanhope Building at Providence, R. I., and under the direction of Messrs. Carpenter, Stone & Wilson, architects, a total load of 22,349 lbs. was applied on an area of 4'x4'10". The clear span between beams was 5 feet, and although this load was 1,156 lbs. per square foot, there was no resulting deflection.

These expanded metal-concrete arches, with, or without, an artificial stone finish, constitute, on account of their light weight and the small space they occupy, as also because of their fire and waterproof qualities, the ideal construction for electrical power houses and stations.

The New Warren Inductor Alternator.

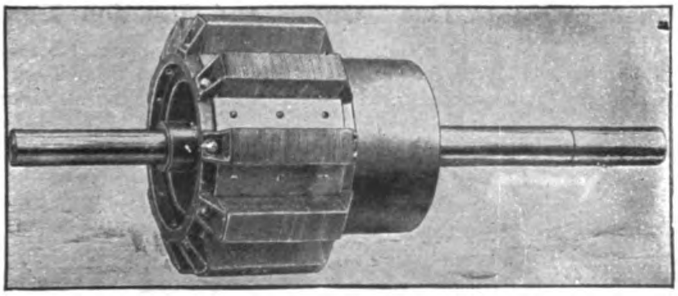
THE inductor type of alternator has come to be recognized as one of special value, and particularly is this true of power transmission where high voltage is necessary and continuous operation essential. Inductor alternators are best adapted to this class of work, due to the fact that the revolving part carries no brushes, commutator or wire, and the only attention the machine requires is the maintenance of a proper lubrication of the bearings. With this latter point provided for, the machine may be kept in uninterrupted service indefinitely.



FIELD COIL WARREN INDUCTOR ALTERNATOR.

Another very important consideration for any class of work is the insulation of the armature coils. This can only be obtained satisfactorily in stationary armatures, because in such there is practically unlimited space available for insulation, and the coil's are not subjected to the mechanical strains accompanying revolving armatures. In inductor armatures the coils are carried on a rigid structure and may be insulated to any required degree. Any pressure above 2,000 volts is extremely hazardous in revolving armatures, while with stationary armatures 10,000 volts is a practical working pressure.

With these salient advantages pointed out, our readers will be interested in the description of the new Warren inductor alternator built by the Warren-Medbery Company, of Sandy Hill, N. J.

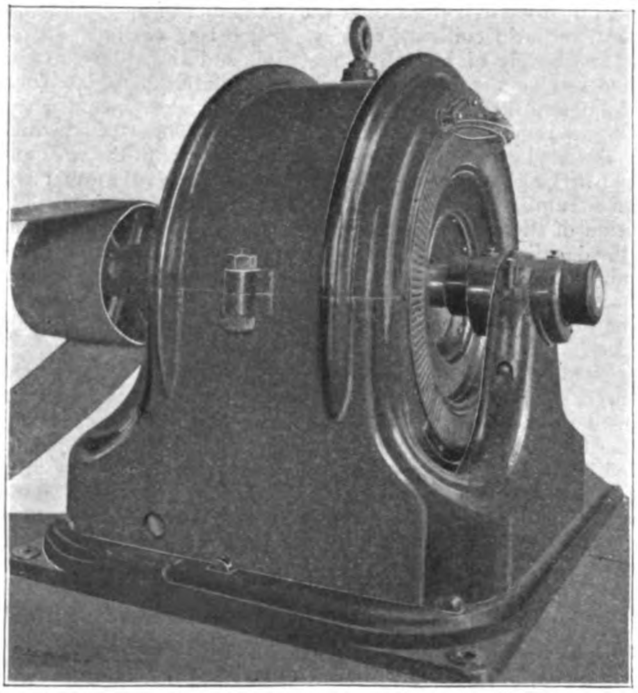


REVOLVING INDUCTOR, WARREN INDUCTOR ALTERNATOR.

As will be seen by the accompanying illustrations, the lower half of the frame of the machine with the base and supports for bearings, constitutes a single casting, insuring great strength and rigidity in the machine, guaranteeing the accurate centering of the revolving inductor while assembling the machine and maintaining perfect alignment while in operation. The bearing sleeves are lined with a high grade of anti-friction metal; the bearing surfaces are unusually large, and the peripheral speed of the shaft in the bearings is moderate. The bearings are self-oiling from an oil reservoir of large capacity, and the distribution of oil throughout the bearings is abundant, being effected by a peculiar arrangement of oil ducts in the interior of the bearing sleeves. The bearing sleeves are made solid, as being the most convenient form for babbitting, in case it should become necessary to re-line the bearings. The supports for the bearings are so designed that when it is desired to remove a bearing sleeve the only operation necessary is the removal of the bearing cap, after which the sleeve may be slipped endwise off the shaft.

The sub-base carries polished steel skids and the machine rests upon these skids with an interposed layer of babbitt, accurately shaped to the configurations of the skids. By means of a powerful ratchet and adjusting screw the belt tension may be easily and quickly regulated.

By the removal of the two frame bolts and opening the armature circuit, on the horizontal central line, the upper half of the frame may be lifted away from the machine. The upper half of the machine carries the upper half of the armature and the corresponding armature coils. The revolving inductor is surrounded at its smaller end by the field coil, which latter is attached to an annular yoke casting. After the upper half of the frame and armature are removed, the revolving inductor, field coil and yoke may be lifted out. By this method of construction, all of the coils of the machine are readily accessible for inspection and repairs.



WARREN INDUCTOR ALTERNATOR.

The armature body is built of a special grade of soft steel, and the method of handling the metal prevents any injuries to its structure, which would increase the losses due to magnetization. For the armature, metal of a very thin gauge is used and the sheets are served on both sides with an insulating compound, which is not affected by heat or age. By this means, the armature eddy currents are thoroughly broken up and practically no loss of power occurs from heating. In addition to this, there are a series of recesses between the cast frame and the outer circumference of the armature, which admit of the free circulation of air entirely around the armature. These recesses are entirely internal and the exterior of the frame casting is retained smooth and symmetrical, without unsightly openings for ventilation purposes. The machine operates remarkble cool, as no part rises over 50 degrees F., even when operated continuously under ten per cent overload.

The armature coils are machine wound and of a plain oblong type, with easy corner bends. This simple form of coil reduces to a minimum the hazards of winding, for neither the armature of the wire nor its covering are subjected to the strains attendant upon the winding of complicated shapes with shape bends, or of coils which are forced into place in the armature. These coils

are thoroughly saturated with an insulating compound, which has no affinity for the copper, but preserves the covering of the wire. For retaining the shape of the coil, a single layer of untreated tape is wrapped all around, and over this a thick coating of waterproofing compound is applied, which makes it practically impossible for moisture or oil to penetrate the insulation of the coil. The insulation of coils is mainly obtained from a special insulation, through which forms the interior lining of the coil slots in the armature. These troughs are semi-flexible, practically non-combustible, do not absorb moisture, are not affected by oil, and do not deteriorate with age. The troughs for 1,000 and 2,000 volt armatures are subjected to a break-down test of 6,000 volts, and the troughs for high voltage armatures are subjected to a minimum of 15,000 volts break-down test. After the troughs and coils are in place in the armature an insulating perforated cover closes up the coil slot and secures the coil and troughs in position. The slot cover is perforated, which allows the revolving inductor to drive a continuous current of air around the coils. This produces such a cooling effect that these machines may be operated continuously, under heavy overloads, without serious heating of coils.

The field coil of the machine is of quite novel construction, for, in effect, it is simply a coil of wire suspended in air; that is, it has the insulation, the radiating surface and the free circulation of air around it, as if it were merely a coil of wire suspended in space in contact only with a number of insulating supports. The field coil case consists of two ring castings, spaced apart with rods of insulating material, and the sides lined at numerous places with narrow strips of insulating material. There is no floor in the case and the sides are cut away, except where backing is required for the insulating strips. The wire is wound over the insulating rods and is in contact only with the rods and strips; it is a skeleton case, which leaves exposed the outer and inner circumferences of the coil, and practically both sides. The rotation of the inductor produces an agitation of air all around the field coil with a constant circulation outside through the openings in the yoke, and the coil will stand severe overloads without injury.

The machines are handsome in design, of fine finish, and incorporate the highest grade of workmanship. The efficiency is remarkably high, being equal in this respect to the best designs of direct current generators, and the inherent regulation is claimed to be by far the best yet attained in alternators of any type. The placing of all the armature coils in a single wreath at one end of the machine and the surrounding of every armature pole with an armature coil, it is claimed, produces better combined efficiency and regulation, and a more correct form of current wave than any other construction. To these features the Warren-Medbury Company has united a robust and workmanlike construction, comprehending simplicity, accuracy and durability, forming a conjunction of desirable features and producing a most practical and reliable machine.

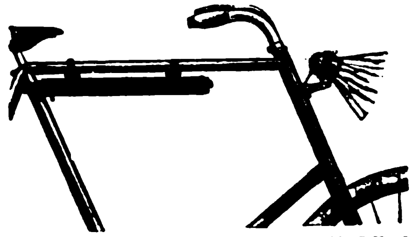
The illustrations are made from photographs of a 150 k. w. machine recently installed in the station of the Ballston Electric Light Company, Ballston Spa, N. Y., by the Warren-Medbery Company. The officers of this company are: H. J. Medbery, president and general manager; H. B. Warren, vice-president and electrical engineer; H. E. Tidmarsh, secretary, and Geo. W. Wait, treasurer. Messrs. Fairchild and Sumner represent the company in New York, with offices at 39 Cortlandt street.

"La Marquette" Electric Bicycle and Carriage Lamps.

The Portable Electric Light Co., of 1242 Marquette Bldg., Chicago, have just brought out a complete line of their "La Marquette" electric bicycle and carriage lamps.

The headlights or reflectors are made entirely of brass, nickel-plated and contain powerful incandescent lamps which are assisted by highly polished reflectors together with imported ground lens. The bicycle reflector can be attached to head or fork of frame as desired. The road wagon lamp reflector, as well as the dashboard lamp, have a neat, secure attachment for the dash. With the improved enamel reflector a perfect focus is obtained, making a clear field of light. The road wagon reflector is four inches in diameter and makes night driving on country roads a pleasure. The dash lamp is put up in very compact form, battery and reflector being encased together in nickel. The hand lamp and watchman's lantern are put up in the same neat form.

The batteries employed are dry cells, and are put up in cartridge form; when exhausted they can be replaced by new cartridges, which can be purchased in all prominent locations,

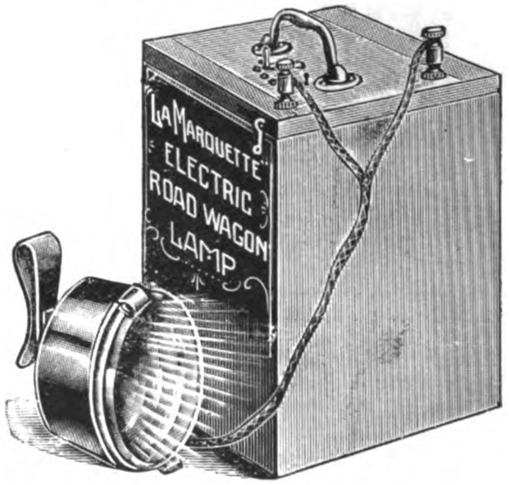


"LA MARQUETTE" ELECTRIC BICYCLE LAMP.

ready for use at a moderate cost, thus avoiding all inconvenience of charging or cleaning.

The bicycle battery is neatly enclosed in a tubular leather case and will fit any make drop or diamond frame on the market. These batteries with a special incandescent lamp will burn fully 15 hours, the last burning hour being of equal brilliancy to the first.

Batteries for dash and hand lamps, as well as the watchman's



"LA MARQUETTE" ELECTRIC ROAD WAGON LAMP.

lantern, are put up in square cartridge form of equal strength with the bicycle batteries. These batteries are enclosed in the same nickel plated case that the reflector is attached to.

The road wagon batteries are encased in handsome hardwood boxes with brass trimmings and show 60 to 75 burning hours with special incandescent lamps.

Chase "Knock Out" Outlet and Junction Box.

L. A. Chase & Co., Inc. 161-163 Fort Hill square, Boston, Mass., have lately placed on the market the Chase "knock-out" outlet and junction box, which has met with general favor

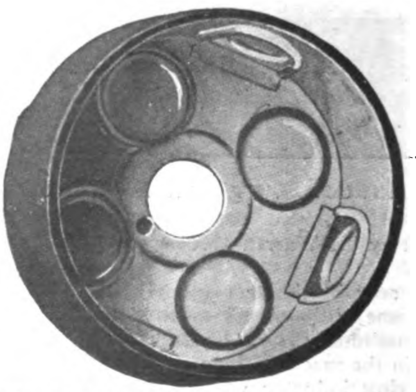


FIG. 1.—CHASE CEILING OUTLET BOX.

among electrical contractors and boards of fire underwriters. This box is made of special grade of iron, and heavily coated

with a hard, black enamel, having the best insulating qualities. The box is so constructed as to have, at frequent intervals on its surface, thin webs or films which a slight blow of a hammer will "knock out," leaving round holes for outlets in as many combinations as are generally required.

The method of attaching the box to the conduit is new, and has many advantages over usual forms now in use. A hollow bushing or nipple, which is threaded on the exterior and smooth and insulated with enamel on the interior, is passed through the hole made in the box at the point desired, and screwed into the coupling on the end of the conduit. This makes a perfect mechanical connection, which can be made watertight. By means of this nipple, wires can be readily pulled through the tube into the box without any danger of abrasion or injury to the insulation of the wires. This will prevent the frequent and troublesome grounding so often met with in outlet boxes. One great objection to boxes in general use is the impossibility of removing them, if broken or injured, without removing considerable other work that has been completed.

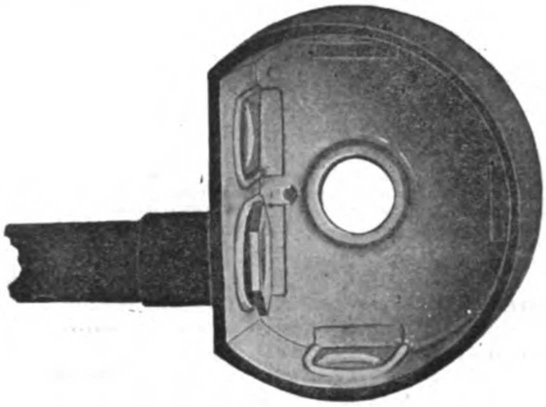


FIG. 2.—CHASE WALL BOX.

FIG. 3.—CHASE NIPPLE.

The Chase box can be instantly disconnected from the conduit by unscrewing the nipples from the inside of the box, thus allowing the box to be withdrawn, regardless of the number of conduits that enter it.

Fig. 1 represents the ceiling outlet box, which may be used for the outlets where the conduits enter from the side or the back of the box. The hole in the centre of the box allows for a support for the fixture, or, if used in combination work, the gas-pipe nipple, to come through. However, in combination work it may be preferable to have a sleeve to prevent the gas pipe from coming in contact with the wire. For straight electric work, where no gas pipes are used, this may be used also for a wall outlet.

Fig. 2 is designed for a wall box, where two conduits enter, both on the same side, which is a very common occurrence. This box can also be used to good advantage as a ceiling box when outlets come on the bottom of iron beams. The diameter, being small, allows the use of ordinary fixture shells.

The Chase nipple shown in Fig. 3, which is meeting with so much favor among electrical contractors, is constructed from a special grade of metal, having an exceedingly tough nature, and is made with a hexagon head, which allows the nipple to be easily screwed into coupling on end of conduit. The nipple is thoroughly painted with a special hard drying enamel that adheres firmly to the metal and will not chip off. In drawing in the wires the nipples are of special advantage, as they prevent abrasion and the wires are drawn much easier. These can also be used to great advantage at outlets where boxes are not to be used.

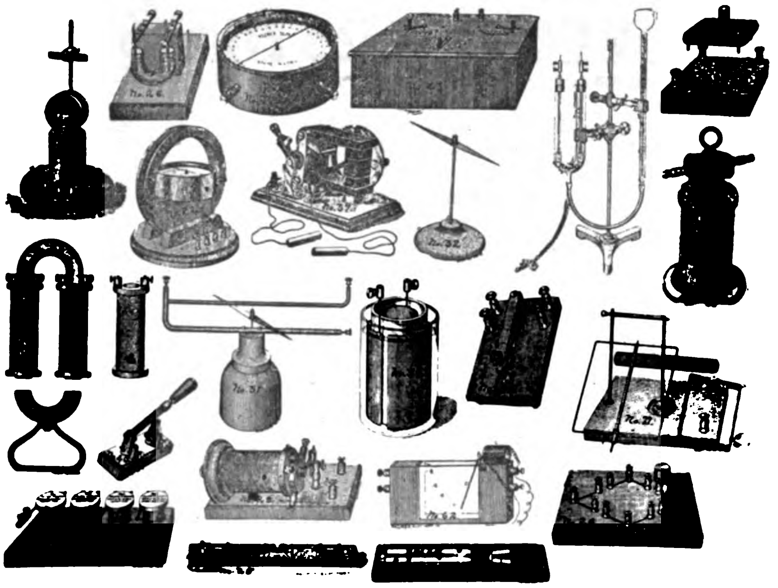
A booklet, entitled "Treatise on Knock-outs" is published by the Company, and will be mailed to anyone on application.

Experimental Electrical Apparatus.

THE experimental set of electrical instruments manufactured by the Palmer Electrical Instrument Co., of Philadelphia, is especially designed to meet the requirements of those engaged in the study of practical electricity or employed in electrical industries. To become familiar with the laws governing electrical currents, one must experiment with them, and this becomes most readily possible by use of the "complete experimental set."

The instruments are durably constructed and handsomely finished; they are thoroughly practical and moderate in price, yet flexible enough to illustrate all the fundamental principles of magnetism, electro-magnetism, voltaic electricity, electro-chemistry, electrical measurements, electro-magnetic induction, dynamo-electric machines, etc.

The apparatus shown in the illustration will be appreciated by instructors in physics courses, where many students perform the same experiments simultaneously; it is also adapted to the equipment of independent electrical laboratories, as an adjunct to



COMPLETE SET OF PALMER ELECTRICAL INSTRUMENTS.

courses in electricity, in manual training and high schools, Young Men's Christian Associations, etc.

Western Electric Fan Motors.

During the warm weather it is necessary to make places of business cool enough to enable the occupants to accomplish their usual amount of work and do it in comfort. Hardly an office, store, or any other place of business is nowadays without the means of creating a cooling breeze, and for this purpose it has been found that there is nothing better than the Western Electric 1898 desk and bracket fan motors. Their convenient size, three speeds, and good mechanism (all of which are described in details in Bulletin 2-F issued by the Western Electric Company), make them most desirable. A copy of Bulletin 2-F will be mailed to anyone requesting it.

The Western Electric Company has designed fan motors that can be connected up directly with 220 or 550 volt circuits without the interposing of any resistance. This company also states that three of its 110 volt motors or two of its 220 volt motors can be run in series on 500 volt circuits and the 550 volt motors can be placed on 600 volt circuits.

General Electric Lightning Arresters.

"Lightning Arresters," is the title of a short treatise, from the press of the General Electric Company, descriptive of the devices which it has developed for preventing injury to electrical apparatus by lightning. The introduction is a short examination of the qualifications necessary to a perfect lightning arrester, with a short disquisition on the special advantages of the magnetic blow-out. This is followed by concise descriptions of the arc and incandescent station arresters, already well known as types

"A," "AA," and "B." Greater space is given to the more recently developed lightning arrester for direct current circuits up to 850 volts, and to the G. E. short gap arrester, especially designed for alternating current circuits and in use on almost all of the great electric power transmissions of the West. The booklet is well written and printed, the illustrations are excellent, and the diagrams of connections clear and distinct. We understand that "Lightning Arresters" will be furnished by the supply department of the General Electric Company on application at any of the sales offices.

Stanley Electric Manufacturing Co.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., have just moved their New York offices from No. 39 Cortlandt street to the new Empire Building, corner Broadway and Rector street. Their offices there are on the tenth floor, and will be more commodious and better adapted to accommodate the conditions of their growing business.

ADVERTISERS' HINTS

ZIMDARS & HUNT, 127 Fifth avenue, New York, have placed on exhibition at the Electrical Show a full line of switchboards, panel boards, feeder boards, knife switches, automatic switches, automatic motor starters, etc. Their catalogues "A," "B' and "C" are descriptive of these goods, and may be obtained on application.

THE GREENVILLE ELECTRIC CO., Greenville, Pa., are refilling fuse plugs at two cents each.

THE H. W. JOHNS MFG. CO., 100 William street, New York, advertise toggle clamp cable insulators and trolley line materials.

J. J. McCABE, 14 Dey street, New York, calls attention to his double-spindle lathe as an ideal tool for repair shops. It is practically two lathes in one.

THE AMERICAN ELECTRICAL AND MAINTENANCE CO., 451 Greenwich street, New York, are introducing a tool for turning down commutators while the armatures are running in their fields. It comprises a carborundum wheel run by belt power from the armature, and takes off a fine cut, making the surface smooth and true to the bearings and brush holder studs.

THE WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa., advertise a great variety of motors to suit all classes of service.

THE GENERAL ELECTRIC CO., advertise their '98 models in fan motors.

THE WARREN ELECTRIC & SPECIALTY CO., Warren, Ohio, offer four cash prizes for the best name to christen their anti-trust incandescent lamp.

THE AMERICAN ELECTRIC FUSE CO., 521 Wabash avenue, Chicago, Ill., invite requests for prices on their combination lightning arrester and cut-out for telegraph and telephone instrument protection.

THE AMERICAN DISTRICT STEAM CO., Lockport, N. Y., under the heading, "How Coal Bills Were Paid for an Entire Year," tell how this may be accomplished by the use of the Holly system of heating by exhaust steam.

THE SPRAGUE ELECTRIC CO., of New York, are advertising the conduits for interior wiring, formerly made by the Interior Conduit and Insulation Co. These goods have long been standard.

PERU ELECTRIC MFG. CO., Peru, Ind., advertise porcelain sundries.

DE VEAU & CO., New York, have taken an order from the U. S. Government for fourteen sets of telephones for submarine divers.

W. S. TURNER, M. S., has removed his office to the new Washington Life Building, No. 141 Broadway, corner of Liberty street, New York, where he will hereafter conduct the business of electrical and mechanical engineering and construction. He will be pleased to be favored with calls and inquiries of friends and clients.

A CORRECTION.—In the article on the St. Anthony Falls water power plant it was stated that the water wheels which run the two 100 k. w. exciters were built by the D. S. Morgan Water Wheel Co., of Dayton, O. This was an error. The wheels were built by the S. Morgan-Smith Co., of York, Pa.

THE BUCKEYE ELECTRIC CO. are finding a large sale for their special anchored filament 220 volt lamp. Life and candle power tests in actual service, prove this special type of "Buckeye" lamp to be among the leaders in its class. Catalogue and prices can be had from Cleveland, or 753 Monadnock Bldg., Chicago.

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The Electrical Engineer.

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ELECTRIC TRANSPORTATION

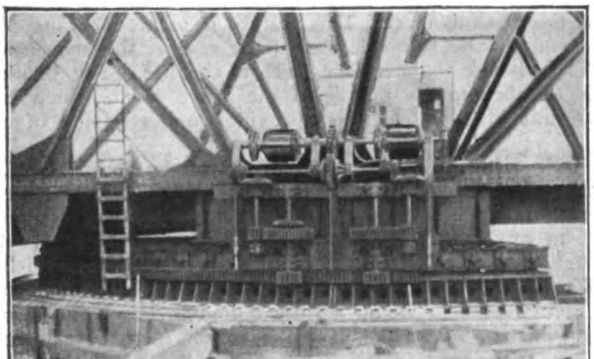
Electric Power on a Big Chicago Bridge.

BY J. R. CRAVATH.

THE Chicago & Northwestern Railway last month put in position at Chicago one of the most important railway drawbridges in the country. It replaces an old bridge and over it all trains entering the Northwestern passenger terminal must pass; the numerous through trains leaving for all parts of the Northwest and the heavy suburban business done by the road over its three lines running out of Chicago. Not only must the regular trains arrive and depart over it, but trains cross it going to and from the yards which are on the side of the Chicago River opposite the depot. The only other railroad bridges in the city which equal it in frequency of trains are the Metropolitan and Lake street elevated railroad bridges.

As a matter of course electric motors are used for swinging this bridge, the steam swung drawbridge being a thing of the past where electric power is available for the purpose. The contract for the electrical part of the bridge equipment was let to Geo. L. Nichols & Bro., of Chicago, who are old timers in this work and who carried it out with their usual promptness. There were no new electrical problems in connection with the bridge, but the peculiar mechanical structure required some new features in mechanical design.

The bridge is swung with two 30 h. p. motors furnished by the Jeffrey Manufacturing Company, of Columbus, O. They are of the enclosed type very similar to a railway motor. The circuits are arranged to run them either two in series, two in multiple or each one independently from a 220 volt circuit. The power is furnished from the depot lighting and power plant, a short distance from the end of the bridge, of which A. J. Farrelly has charge. It is the custom at present to operate the



ELECTRIC MOTORS ON DRAWBRIDGE OF CHICAGO & N. W. RAILROAD, CHICAGO, ILL.

two motors in series as this gives the greatest torque with the least current and so far has given speed enough for practical purposes. Later in the season when the bridge is "limbered up" and river traffic is heavy it may be necessary to increase the speed by operating motors singly or in parallel.

Plain rheostat control is used and the switching in or out of either motor is done with two double pole switches in the controlling cabin. The current from the power house is also usually kept off the controller and motors by a main double pole switch in the cabin which is closed when the motors are to be operated. The controller is the usual type furnished by the Jeffrey Manufacturing Company for this class of work and has a handle which is vertical when at zero and is moved either way from zero to go ahead and reverse. The motors are protected by a fuse of large capacity in the motorman's cabin and by a Cutter circuit breaker at the power house in the motor circuit.

Compressed air plays an important part in the control of the bridge. It operates the signals at the approaches and the catch which holds the bridge while it is closed for train traffic; lifts the rails at the ends of the bridge before it is opened and operates wedges which relieve the pivot of the weight of the bridge when it is not being swung. The only brake employed is worked by a foot treadle in the cabin and acts as a clutch brake on the motor shaft. No great braking power is needed with a bridge of this kind. The bridge is pivoted at one side of the center instead of under the center as swing bridges usually are. The weight of the bridge is carried by the pivot and by a carriage on the opposite side from the pivot. The motorman's cabin is located over the pivot and the motors are over the carriage just across from the cabin. The weight of the bridge is about 200 tons.

The object of the peculiar pivot and carriage mechanism is to prevent the end of the bridge from fouling the Kinzie street draw just north of it when both are open. By putting the pivot at the south side of the bridge instead of the middle the short space is gained which allows the two bridges to clear each other. The design is that of Engineer W. H. Finley, of the Northwestern road.

Electric Street Railways in Baltimore, Md.—Notes from the Field.

BY C. B. FAIRCHILD.

TWO companies, the Baltimore City Passenger Railway and the Baltimore Consolidated Railway Company, control most of the street railway mileage in the city, or about 300 miles of a total trackage. In the practice of both systems are found many interesting features, which may be included in the sum of modern standard practice, and are so made available for all who may wish to compare or improve their own practice.

The only remaining cable line, operated by the Baltimore City Passenger Railway is about to be transformed into an electric line. The overhead wires are up, the motors are bought and new power installed. It is interesting to note in this connection that this change was anticipated some time since by the management, or about a year and a half ago, when a change was made in the gripping device and method of operating the cable car. Formerly the cable cars were operated in trains, consisting of an open grip car and trailer. The train system still prevails, but the open grip cars have been converted into trailers, and the closed cars used for the grip car. These closed cars have 16-foot bodies, and when the change was made were mounted on Peckham trucks, and the Earl, or Broadway, grip was substituted, and is operated from the front platform. These trucks were provided with heavy axles, having key seats, and every feature to be readily adapted for electric motors. The open 16-foot cars were converted into trailers, and are run the year round. The same train method will continue now that electric power is to be substituted. After the change of grips the speed of the ropes was increased, but the accident record was reduced, owing to the position of the gripman on the end of the car, and since the change not a delay of any kind has occurred on this system.

The new motors, of which 85 equipments have been purchased, are of the Westinghouse No. 49 type, and were selected because of the previous excellent record made by the Westinghouse motors on the present electric line, which have now been in operation about four years, and during that time not an armature has been destroyed out of the 423 equipments; two only have been injured by lightning, and these required only slight repairs. Two boys do all the winding repairs necessary on the armatures and field coils, making the expense for this class of repairs very light. This result is obtained by careful inspection by both the day and night men, and because of the practice of thoroughly overhauling the electrical equipment of each car every two weeks. The speed of the cars not being limited by city ordinance a very high rate is attained on some of the outlying sections. Considering the high speed and

heavy surface, there being many steep grades, the motor record is a phenomenal one.

POWER STATIONS.

Two electric and three cable stations now generate the power for operating the entire system. The manager is now considering the advantage of erecting a central station from which all the lines can be operated electrically. The plans contemplate the installation of direct coupled units, driven by engines of the latest approved type.

The principal electric station now employed is located on Light street, and the steam is generated in Campbell & Zell boilers, equipped with Roney mechanical stokers, in which George's Creek coal is employed.

The electric equipment of the station is all of Westinghouse manufacture, and the development has been as follows: First. Three units of 500 kilowatts capacity each, the multipolar generatirs being belt-driven from an Allis-Corliss high pressure engine. About eighteen months ago a direct coupled unit was installed, consisting of a 750 h. p. Rice & Sargent engine, running 90 revolutions per minute. The peculiar features of this engine are two eccentric rods for operating the steam and exhaust valves separately. The generator is of 500 kilowatt capacity, with a rated output of 910 amperes, but has been run up to a load of 2,100 amperes for 20 minutes without injury. Since the installation of this machine there has been no change or adjustment of the brushes, and no repairs have been necessary. It is stated by the engineer in charge that this engine, although running at ninety revolutions, consumes less oil than the other engine with a speed of only 66 revolutions.

The latest addition to the station is a motor-driven 900-volt booster, which has just been installed by the Westinghouse Company. This has been found necessary in order to supply the current to a seven and one-quarter mile line, on which are heavy grades, and at times an excessive amount of traffic, owing to the location of a bicycle colosseum which sometimes attracts as many as 20,000 people a day.

The station is equipped with Wurtz's lightning arresters and tank arresters; the Wurtz arresters are also employed on the line. This locality being subject to frequent and heavy electric storms the lightning arresters become important features, but this station is never required to shut down during a storm.

REPAIR SHOP PRACTICE.

In the woodworking department only one machine is employed; this is known as the Universal woodworker, and was manufactured by M. B. Tidey, of Newark, N. J. This machine can be adjusted to do all kinds of woodcutting, including mortising and boring.

The iron working tools are large and are ample for a still larger shop. Among the shop "kinks" we note a peculiar arrangement of the template, adjusted to a large drill press, by which the gear cases, which are manufactured by the company, are readily drilled and fitted. There is also a mould for making lead gaskets for use on the Zell boilers. These gaskets are used instead of those made of rubber, which are too expensive owing to the great quantity required for this type of boiler. The lead gaskets are first cast as a round band, having corrugations on each side. These are then placed over an adjustable mandrel, and by means of a short lever, the bands are stretched into an oval form, and to an exact fit for boiler opening.

A home-made armature and axle lift is employed in the repair pits for removing armatures or axles. This consists of a low platform, mounted on castor wheels, having handles for drawing it about. Iron posts at each corner support a second platform on which is mounted a short shaft, carrying two five-inch sprocket wheels. The shaft is moved by means of a crank handle, having a three-inch pinion meshing into an eight-inch gear on the main shaft. The gear and pinion employed were taken from the platform equipment of a type of brake formerly employed. Over the sprocket wheels a chain is looped with the lower ends attached to a vertical plunger, consisting of a three-inch pipe, which carries on its upper end a swiveled curved seat to fit an armature. By the motion of the crank the seat is lifted up or down with a range of twenty-five inches. By this means an armature is readily removed and transferred to any part of the pit and rolled out upon the floor without any heavy lifting.

Axles are removed by the same device; one of the pits being especially constructed with a removable section of rail so that it can be operated. The car is placed on the section and lifted by means of four Yale triplex hand hoists. By removing the short section of track the axle is lowered by the lifter and swung around and removed to any part of the pit, the same as described for the armature. A new set of wheels and axles are replaced in the same manner without any excessive lifting on the part of the employés, and without straining the car body, as is the case when only one end of the car body is jacked up for the replacing of wheels.

The car wheels are purchased for the most part from the New York Car Wheel Works of Buffalo.

ROLLING STOCK.

In remodelling the old grip cars for use as trailers, the position of the side truss rod was changed, or, rather, they were lifted to give a greater supporting power. The middle portion consists of a straight length of flat iron bar two inches wide let into the post just below the windows, from the ends of which the truss rods proper descend to the end of the car sills, each end rod being provided with a turn buckle for adjustment. Cross truss rods are also employed with each cross sill.

The standard lettering for all cars, both for the name of the company and for designating the routes, is a plain block letter put on with stencil plates, brass stencils being employed. The exterior decorations are very meagre, and consist of a neat border on each end of the main panel. The cars are numbered at the middle of the sign panel, and on the corner of the dashboard. The inside number is placed near the register. Twenty new open cars have recently been purchased from the American Car Co., of St. Louis; these are 31 feet over all.

The deck lights for all the cars are of white glass, except those in the end which are colored for the different routes. A considerable saving is effected by employing plain glass, as when broken it can usually be placed by strips cut from the broken window panes. The cars are all provided with 10 incandescent lamps making them especially bright and attractive at night.

A novel method of operating the brakes has been devised by the master mechanic, and adopted by the company. This consists of a short vertical lever pivoted in a bracket attached to the suspension bar of the truck near the side bar. To the upper end of the lever the brake chain is attached, and two rods, one above and the other below the pivoted point of the lever extend in both directions to the end of the floating lever of the brake mechanism. Each end of the car at diagonal corners is provided with the same equipment, and the side rods of each equipment become in turn anchor rods for the opposite ends of the floating lever. This feature is secured because the vertical rod on the idle side rests back against the suspension bar. The pivotal support being below the bar. The floating lever is attached to the middle of the brake beam, which is a flat bar, and rides in channels provided on each side of the truck.

The ends of the brake bars are reinforced by a thin thimble of metal, which is shrunk on, and which takes the wear from the sliding motion. These thimbles are rounded at the outer edge to prevent any cramping of the brake beam should there be any difference in the travel of the ends. The Christy head has been discarded, and the brakeshoes are cast with a flat lug, which admits of their being readily bolted to the brake beam. Springs hold the shoes free from the wheels in the usual manner.

The cars are all equipped with a home-made fender and a wheel guard. The fender is composed of a frame work of pipe carrying rope netting. There are two main bars, and the fender has the form of a fish mouth. The fender is proving very efficient, as the records show that 299 lives have been saved by them since their adoption in 1895. The wheel guard consists of small iron rods looped, which are fastened to a bar hung in front of the wheel near the paving, and which has the appearance of a large comb, with the teeth parallel with the roadbed.

DISCIPLINE.

It is seldom that one finds a body of railway employés more faithful or more loyal to the company than the men employed by the Baltimore City Passenger Railway Company. This the General Manager, Mr. F. L. Hart, ascribes to the manner of administering the discipline, and the treatment given to the men by the heads of the departments, as much attention being given to this branch of the service as to that of the mechanical department.

Orders are issued to the superintendents and foremen that all men serving under them be treated with the same respect and consideration that they themselves would expect to receive were their positions reversed. The use of profane or angry epithets in dealing with an employé is forbidden, and the men are encouraged to have the same respect for each other. The superintendents and heads of departments are granted two weeks' vacation each year, with full pay, and they are allowed to go where they like. Provision is also made for some of the assistants to visit other cities, where they may study the street railway practice of other lines. The master mechanic has been delegated at different times to visit car and truck manufacturing establishments in order that he may get the benefit of such practice as may be made available to local conditions. Liberal dealing in this direction pays in the estimation of the manager a hundredfold.

The car men are required to wear service stripes on their coat sleeves to indicate the number of years of continuous service with the company. A new stripe is added every five years, and among the thousand or more employés 150 or more are now wearing a service stripe; while two of the men have seven stripes, two others five, and two four, each. It is observed that men wearing service stripes receive more respect from passengers, and in case of difficulty they seem to have more power in enforcing a compliance with the rules. The men themselves all strive for clean records that they may secure the stripes. In case it becomes necessary to inflict any penalties, or discharge for any cause, it is done only after careful investigation, and by vote of three members of the Board, detailed for the purpose; even the General Manager does not assume to exercise authority in these matters without the co-operation of some of his associates; this insures justice being done to all concerned. The men are required to pay for damage to the car from careless running, and for flat wheels.

MUNICIPAL REQUIREMENTS.

The aggregate city tax imposed on the companies by the local authorities amounts to 20 per cent. of the gross receipts. There is a special tax of 9 per cent. for Parks, and in addition to car license a real estate tax, so that the company makes a practice of charging off 20 per cent. of the gross receipts each day to meet these requirements. Notwithstanding this a dividend of 10 per cent. is usually paid.

A liberal system of transfers has been adopted and a different colored ticket is employed for use at certain periods during the day; the days being divided into three periods to correspond with the color of the ticket. A Steadman type of ticket is employed.

In the matter of accident cases it is the policy of the company to settle promptly before the cases can be taken into court. A regular physician is employed, who spends two hours every morning at the Company's office, looking over and investigating the accident reports. Careful records are made of each case, which are then filed in a ready reference case.

Uniforms worn by the men are made from the standard metropolitan police blue cloth, and the men are allowed to purchase them for themselves. In engaging new men no deposit is required, but all are required to be bonded in a fidelity company, for which the men pay five dollars for the first year, and after that three dollars per year.

Mr. F. L. Hart, the manager of the company, was formerly in the employ of the Third Avenue Railroad Company, New York, as Chief Engineer at the 145th street cable power station, and was later with the Metropolitan Street Railway Company of New York. He attributes his success in the management of the Baltimore system to the valuable experience he had with the above companies, and has only kind words expressive of his regard for his superiors in these companies.

Signs for Trolley Fenders.

"In a brief visit to the borough of Brooklyn, the other day," said a Manhattan boroughite, "I saw on the fender of a trolley car a single sheet poster printed with the announcement of a theatre. I should think that as bill boards the fenders of trolley cars would serve admirably, especially for pictorial work, for circuses, for instance. A trolley car with its fender covered with pictures of lions and tigers, and so on, coming toward the beholder at a high rate of speed, could not fail to be impressive."
—New York Sun.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—XI.

BY A. E. DOBBS.

MANHOLES are also a necessary part of conduit work. They should be large enough to allow a man to get into and do the necessary work of splicing, etc. They should also be lined with brick set in cement; and the floor may be cement, with a drain in the bottom, or if the soil is porous enough, have no floor at all, except some coarse sand thrown in the bottom to keep it clean (Fig. 34).

They should not, as a rule, be more than 500 feet apart, though 1,000 feet of cable can be put through in one length, but where this is done it is better to select the middle manhole and pull both ways from there, as described in a previous chapter on aerial cables. The ends of the ducts in the manholes should

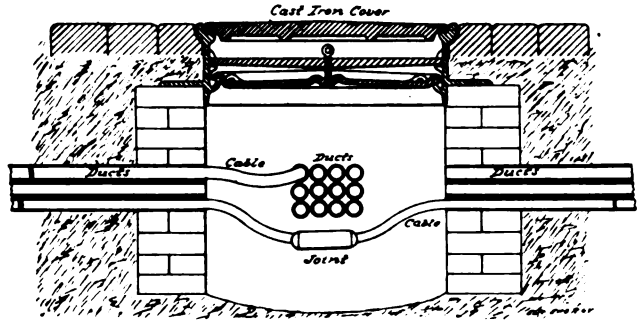


FIG. 34.

also be reamed out, so that no sharp corners, or projections, can possibly mar the cable. They should also have cleats or hangers around the sides so that the cable can be kept out of the way.

There is a diversity of practice in regard to keeping water out of ducts and manholes. Some will use their utmost endeavors to seal up both ducts and manholes, so that no water can possibly get in—but it does just the same—while others make no effort to keep the water out, but put a drain connection at the bottom of each manhole. Others still make no effort either to keep water out or drain it off. If they should open a manhole and find it full of water, they simply pump it out till their work there is finished, and let it go at that. If the soil is sandy or porous, it will absorb all the water liable to accumulate in any conduit system. The manhole covers should, however, be as nearly watertight as possible. Water does not hurt a lead covered cable, and there is no particular use in trying to keep it dry underground.

In London it was the practice to even fill the conduits with water, presumably to keep the cable as cool as possible, and counteract the effect of steam heating pipes. In some downtown districts in New York City, the temperature of the ducts, in places, is almost that of boiling water.

In getting a cable into a duct the first thing is to get an inch rope pulled in. There are various ways of doing this; the simplest way is to pull in a No. 14 steel wire as the duct is laid, and when needed hitch a rope to it and pull it through. Another method much used, is to have several hundred sticks about four feet long, with brass screw joints on each end, one being a male and the other a female thread. As fast as one stick is pushed into the duct another is screwed into it, and so on, till the next manhole is reached, when the rope is hitched in to a swivel, made to screw into the end of the stick, and the man at the next place pulls it through, unjointing the sticks as fast as they arrive.

T. J. Cope, of 3244 North 15th street, Philadelphia, advertises a machine that works its own way through the ducts, cleaning out dirt and other rubbish as it goes along. According to his advertisement he has cleaned and threaded about 9,000,000 feet of duct with it.

To fasten the rope to the cable, spread out the end and pass down over the end of the cable for about two feet, then lash it

tightly, with marlin twine, or wire. Some contractors use an iron clamp that passes down over the end of the cable, similar to that on a wagon tongue, when a couple of holes are punched through the cable, and rivetted or screwed down, the rivets passing through holes in the clamp for that purpose. A loop in the end of the clamp permits of fastening the rope.

To pull through a length of 500 or 1,000 feet will require considerable power; cable contractors use a winch and capstan for this purpose, so constructed that it (the winch) can be placed

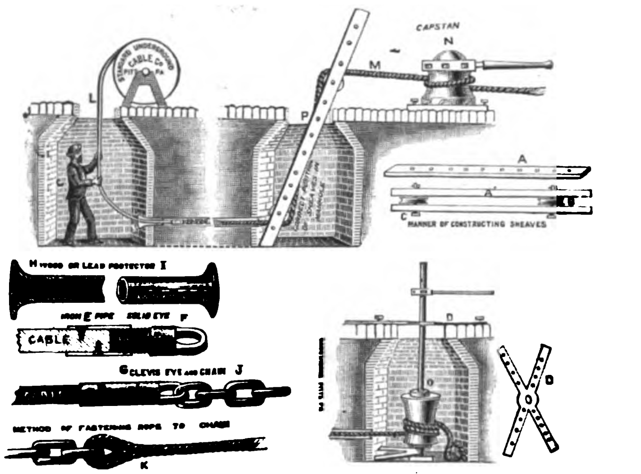


FIG. 35.

in the manhole, while the men can work the capstan bars above ground. But where there is not cable enough to justify this expense, double pulley blocks will do almost as well. The method of using capstans in different positions is illustrated in Fig. 35, which shows the apparatus employed by the Underground Cable Co., Pittsburg, Pa.[1]

In districts where few wires are taken off, a heavy pole probably furnishes the simplest method of distribution, using either double arms faced at right angles to each other, or a circular iron ring about 6 feet across, and held in place by braces made to fit ring and pole. The ring is of angle iron with the lip of the upper angle turned outward. Angle braces are made to fit this ring and pole, both above and below. Around the outer projecting lip of the rim are drilled ¼-inch holes about 4 inches apart, and through these is passed a bolt to connect two porcelain knobs—one above and one below the lip—thus making

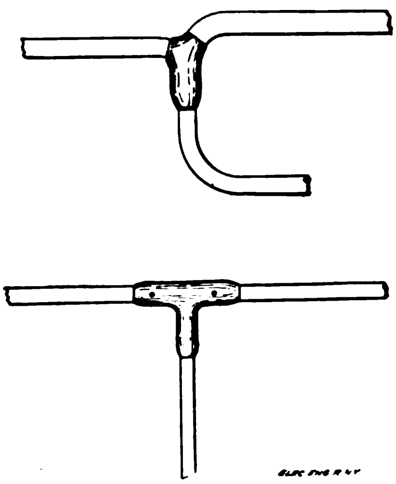


FIG. 36.

place for two wires at each drilled hole. Where a large number of telephones are to be served to one building, as a large office building, the best way is either to come up the side of the building to the roof, or else to take the cellar, and distribute from there.

It is sometimes very convenient to divide a cable into several parts, as described before, but with a difference. Suppose we have a 200-wire cable, which we wish to distribute at four points, A, B, C and D. At A, we will need, say, 50 wires. We take the first 50—for by this time the cable should be numbered at the office end. Now, as we may want some of these wires again, we will not cut them here, but merely "tap in" (multiple) and continue to the next terminals.

From this "split" we run a short 50-wire cable to its terminal outside. At the next station, B, the next 50 wires are tapped; and it might be well to also tap it on the first 50 at this point, as they may be needed to help out the distribution; for one terminal might have more subscribers than it has conductors, while another will have plenty of conductors to spare, and it may be found very convenient to tap some of them. Then the cable may be changed to one of 100 conductors, and connected to C and D, the same as at A and B. Some companies, however, would bring the whole 200 conductors into each terminal. We suppose here we ought to stop and give some directions for making a cable splice.

Bring the two ends together and past each other about a foot or more, according to the amount of end to be wasted. Then strip the lead back till there is about a foot between the two lead sections. Then take a piece of lead pipe a little larger than the cable, and a little longer than the space that separates them, and slip it back over one of the ends. In making joints twist the two ends of the wire together, but before doing so slip a sleeve either of paper or cotton over one of the wires so that when twisted it can be slid over the joint. Cable joints are not soldered. In making joints distribute them as nearly equally as possible, over the space between the two ends to prevent bunching.

When the joints are all made and the short lengths of tube slipped in place, pour them with a mixture of paraffine and beeswax, or whatever is being used; then slide the lead sleeve so as to cover the two ends, and make a "wiped" joint. If the men handling this work don't know how to wipe a joint, hire a first-class plumber to do it, and be sure that the joint can be depended on not to leak, though the plumber should understand this.

In making a tap (split) joint, three ends are brought together instead of two. (See Fig. 36.)

Some men like to leave a hole in a joint sleeve, and fill it full of insulating compound, soldering up the hole again afterward.

REMARKS ON ELECTROLYSIS.

With wood or tile ducts, the "ground" on the cables should be so evenly distributed over the entire system that there should be no trouble with electrolysis. As said before, the same class of duct should be used even to the foot of the pole, or, if it is necessary to use iron pipe, do not extend it into the earth more than two or three feet from the top of the ground, and wrap that part of it in burlap, thoroughly soaked in tar, to prevent direct contact. Of course a cable up the side of a pole, or house, needs some protection, but tile can be found to make the bend at the foot of the pole, and galvanized sheet iron bent over the cable and nailed down, is almost as efficient.

Now, the only trouble from electrolysis comes from street railways, or power circuits, with a ground return, and is caused by an escape of current from the ground wire. Suppose there is a loss in the trolley wires, from the power house to the end of the line, of 250 volts, as frequently happens. Some of this is used in overcoming the resistance of the conductors, but a large part of it is lost in the ground return, and a great deal of it strays away to water, gas, or cable pipes in the vicinity. Now, where the current enters these pipes there is no harm done, but when it leaves them again like a freebooter that it is, it takes part of the pipe along with it. (The text-books say that it sets free oxygen, which enters into active combination with the metals, but the effect is just the same.)

Its presence is indicated by decay and pitting of the pipes affected, and a visit to the power house should be made forthwith. If it is found that the negative bus-bar is the one connected to ground, there is nothing more to be done there, unless it may be that the ground return is not heavy enough, in which case you may be able to make some arrangement in regard to it. (If a bonded track return only is used, it is a very uncertain factor.) If the positive bus-bar is connected to the ground, it should be changed.

But if everything is all right in the power house, there is only one thing to do: to go back to where the damage is being done and connect the cables or pipes to the track return

[1]Fig. 35 is reproduced by permission from a handbook by the Standard Underground Cable Co., Pittsburg, Pa.

with a heavy copper wire; and if any more signs of decay are found to continue to connect it at intervals of every half mile or so, that it, provided it parallels the track that far.

All this will have a tendency to make a noisy cable, but it cannot be helped.

Electrolysis of course does not bother aerial cables to any extent.

As the static capacity, inductive and electrolytic effects are largely increased by the proximity of the earth, underground are therefore not as desirable as aerial cables, for with an extensive underground system metallic circuits become almost a positive necessity and the only thing to be said in favor of an underground system is that it is not affected by storms and, therefore, gives continuous service. It does not obstruct the streets with hundreds of wires, some of which are liable to break and cross electric light and trolley wires.

The city of Pittsburg has had a lively experience of that kind in one or two blizzards last winter, when men were shocked, horses killed and the rest of the citizens terrified into nervous prostration—at least the newspapers said so.

The static capacity of bare wires overhead varies from .0144 to .0160 microfarads per mile, while underground paper cables vary from .06 to .10 microfarads or from five to seven times more and induction effects in about the same proportion.

The nearer we get to the earth, the greater the wave distortion and success in telephony depends very largely upon our ability to preserve these waves in their original form.

The following specifications follow closely those laid down by the different Bell companies:

1. Each conductor shall have a diameter of 40 cir mils (No. 19 B & S, though they are sometimes larger than this and may be even as small as No. 22), with a copper conductivity of 98 per cent.

2. The conductor shall be insulated, with two paper tapes, twisted in pairs, the length of the twist not to exceed three inches, and formed into a core arranged in reverse layers.

3. The core shall be inclosed in a pipe composed of lead and tin, and the amount of tin shall not be less than 2.9 per cent. The pipe shall be formed around the core and shall be free from holes or other defects and of uniform thickness and composition.

4. The average electrostatic capacity shall not exceed .080 of a microfarad per mile, each wire being measured against all the rest and the sheath grounded; the electrostatic capacity of any wire so measured shall not exceed .085 microfarad per mile.

5. Insulation from 100 to 500 megohms (100,000,000 to 500,000,000 ohms) per mile at 60° F. and a conductor resistance of not more than 47 ohms per mile connected to terminals.

Denver Telephone Sub-Station.

To accommodate its increasing business in the residence district in the city of Denver, the Colorado Telephone Company has built a sub-station at the corner of York street and Colfax avenue. The structure, which will be one story and a basement, will be completed by July 1. When the station is finished it will have a capacity of 2,100 subscribers, but at the outset probably not over 250 instruments will be connected to the exchange. The sub-station is located about two miles from the company's building on Lawrence street, and the two exchanges will be connected by trunk lines.

A VOLUNTEER SIGNAL CORPS. The U. S. Senate has passed a measure authorizing the enlistment of a volunteer signal corps, two-thirds of whose members must be expert electricians or telegraphers.

Entertainments at the Chicago Convention.

We open our forms to note that the Chicago Local Reception Committee on Monday arranged as follows for the entertainment of visiting members and friends of the National Electric Light Association: Reception at the Auditorium Monday evening; excursion on Lake Michigan Tuesday evening; lecture by Mr. Joseph Wetzler Wednesday evening; coaching parties through the Parks and Boulevard system and suburbs, with luncheon, for ladies, for Tuesday and Wednesday, during the hours of meeting. There are six papers and five topics for discussion.

MISCELLANEOUS

Current Transformers.—I.

BY CHARLES T. CHILD.

THE extending use of several different varieties of electric current, each of which possesses qualities fitting it especially for particular applications in the arts, has called into existence a number of machines and methods for the transformation of one kind of current into another. Electric currents may be broadly divided into three classes: direct continuous, direct pulsating, and alternating, and these are further distinguished as currents of constant volume or constant difference of potential between the two sides of a conducting system, and as single-phase or polyphase.

Three varieties of direct current are in extended use, the constant potential supply systems for lighting, railway work and electrolysis; the constant current supply systems for arc lighting, electrolysis and occasionally for power transmission and other purposes; and the pulsating current for arc lamps, in telegraphy and, less frequently, for electrolytic and similar purposes. The most frequent occasion for transformation between one variety of direct current and another is when it is desired to change the voltage of a constant potential supply system. It is not necessary here to go into any description of alternating current voltage transformers, since these are of peculiarly simple and well known construction.

The only methods for the voltage transformation of direct currents are by the use of motor-dynamos or dynamotors, and of accumulators which are connected in a certain arrangement for charge at one voltage and reconnected so as to give a different voltage in discharge.

The motor-dynamo is, as its name indicates, a combination of a motor receiving the current to be transformed and driving a dynamo giving out the variety of current desired. Perhaps the most frequent use of this combination, at least in large sizes, is for "boosting" the terminal voltage of an electric light or railway feeder, the supply current being fed to it through a motor-driven series-wound dynamo for this purpose. The dynamotor is a machine having a single field and an armature carrying two windings, one for the primary and the other for the secondary current. These machines have given great satisfaction, especially in small sizes, being much used in lieu of the cumbersome and uncleanly battery for telegraphing, etc. Their efficiency is high, their running smooth and sparkless, owing to the balancing effect of the two armature windings eliminating field distortion, and their output for weight and cost is fairly high. They present, however, a formidable disadvantage not shared by the motor-dynamo, in that the two sides are electrically absolutely interdependent and the voltage of the secondary a fixed and invariable function of that of the primary. Hence any fluctuations in the primary voltage are immediately evident in the secondary, and cannot be compensated as in the case of the motor-dynamo.

Of much greater importance and interest is the transformation of alternating into direct currents and vice versa. The alternating current in any of its forms is, owing to the readiness with which it lends itself to voltage transformations, peculiarly adapted for long distance power transmission. But while such currents may be generated in machines of great simplicity and at almost any pressure and transmitted efficiently to great distances there are certain uses to which they are not applicable in the present state of the art, and certain others to which they can never be applied. Among the former are series arc lighting and electric traction, although it is likely that the difficulties now existing preventing their employment for these purposes will be overcome. For electrolysis, an enormously and increasingly important branch of electrical application, they are totally inapplicable, and, for the same reason, they are useless for charging accumulators.

On these accounts there exists a demand for means whereby the alternating current may be transformed into some variety of direct current. Alternating current systems of supply for lighting and power lack only the one element of capacity for storage and "steadying," possessed by direct current systems in

connection with a battery of accumulators, to be almost the ideal for central station distribution, and this capacity is given them by the reversible transformers presently to be described.

While there is less occasion to transform direct current into alternating this may be easily accomplished whenever desired.

Another set of transformations of great importance is the alteration of the phase relations and distribution in polyphase alternating systems. An example of this is shown in the Niagara-Buffalo transmission, where quarter-phase currents are generated, transformed into three-phase currents for transmission on account of the saving in copper effected by the use of this variety of current, and again transformed into quarter-phase current as a preparation for further transformation into direct current at the receiving end of the line.

One of the first current transformers to be used was the ordinary make-and-break mechanism of the induction coil, giving an interrupted or pulsating current in the primary of the coil and an alternating current of great complexity of wave form in the secondary.

The commutator, introduced by early experimenters to rectify the currents of magneto machines, and now in use for an identical purpose on all forms of direct current dynamos, is the prototype of the rectifier, a machine used with more or less success for the rectification of single phase alternating currents and principally applied for supplying current to series arc systems. In its simplest form the rectifier may be regarded as a revolving reversing switch which reverses the direction of current flow at the moment when the current itself reverses direction, thus giving currents all of one direction in the circuit to which it is connected. It is evident that such a current is of a pulsating character, however, because the effect of the rectifier is simply to turn the current impulses all in the same direction without at all modifying the form of the wave.

Obviously the rectifier may be made in a number of simple ways. It generally consists of a commutator of an even number of segments, alternate segments being connected together and to the source of supply of alternating current, and two or more brushes taking off the rectified currents, either the commutator or the brushes being driven synchronously so that the brushes pass from one segment to the next at the instant of zero flow.

Instruments of this character have been used with considerable success for series arc lighting, notably in England, and it is stated that the pulsating character of the current derived from them is not objectionable, but rather advantageous, since the constant tremor produced in the lamp mechanism prevents the sticking of the rod. There are, however, two serious objections to its use which have prevented its general extension. One is that the maximum voltage on the lines is considerably in excess of the virtual voltage, and the other is that it is practically impossible to maintain the adjustment of the inductance and capacity of the line so that the instants of zero current and zero e. m. f. coincide. In a circuit containing 60 lamps and requiring 3,000 volts at its terminals, the maximum tension, assuming the alternator to give a sine wave, will be about 4,250 volts. This increase in the pressure is necessarily destructive to insulation and provocative of accidents. On account of the difficulty in maintaining the adjustment of the phase relation of current and e. m. f. there is always more or less flashing at the brushes of the rectifier, and while this is not serious with currents of 10 amperes or less, such as are used for arc lighting, it is an insuperable obstacle to the use of rectifiers of this type for large currents.

An ingenious modification of the rectifier, designed for charging storage batteries, is due to Pollak. The commutator has wide spaces between the segments and the brushes can be so adjusted that only that part of the e. m. f. wave higher in tension than the counter e. m. f. of the battery is connected with it, thus avoiding the energy loss that would be due to the momentary discharge of the cells if the applied electromotive force were at any time less than that of the battery.

The efficiency of rectifiers is very high, the losses being only those due to friction and in the motor, if a motor is used for driving. Despite their high efficiency they do not seem to be destined to ever meet with extended use on account of the difficulties of sparking mentioned above.

Another method of rectification that has been suggested employs an accumulator giving a voltage exactly equal to the maximum e. m. f. of the alternating current wave and connected in series with the alternator. Obviously the effect of this arrangement is to extinguish the impressed e. m. f. of the alternator in one sense and to double it in the other, giving rise to a fluctuating unidirectional current wave rising from zero to twice its original value, the total current flow and virtual voltage remaining the same. The cells are alternately charged and discharged but will gradually lose their initial charge on account of internal losses. Certain combinations of electrodes and electrolytes offer the remarkable property of a very much higher counter e. m. f. to currents flowing in one direction than to those in the other, and it has been proposed to use systems of this character for rectification. These methods all possess considerably more interest than value.

When the transformation involves large currents and when it is desired to obtain a direct current of greater smoothness than the pulsating variety delivered by the rectifier, resort is had to one of three methods which will now be taken up in detail and considered with reference to their application to various practical cases. These three methods are respectively the motor-driven dynamo, the single and double winding rotary transformer, and the ingenious machine of MM. Hutin and Leblanc termed by them "panchahuteur"—a term for which there seems no exact English equivalent.[1]

The motor-driven dynamo for transforming alternating to direct current may be composed of any variety of direct current dynamo, coupled or otherwise connected to either a synchronous or an induction motor. The latter is practically never used in large sizes on account of its low power factor, which introduces disturbing elements in the line, and because its speed is a function of the voltage of the supply current and hence liable to considerable variation. The synchronous motor, on the other hand, may always be adjusted for unity power factor by proper field magnetization, or it may be arranged to cause either lagging or leading currents in the line at will. Furthermore, its speed is dependent solely upon the frequency of the supply current and hence upon the speed of the generator furnishing it, and motor and generator keep perfect step together. Hence if the speed of the generator is kept constant that of the motor will be, perforce, also constant, a condition highly desirable in this class of work.

The advantages of a motor-dynamo of this type are that the direct current voltage is independent of that of the alternating current and may be adjusted through a considerable range if desired. The construction of synchronous motors, in which the supply current is received by the stationary part, permits the use of line voltages without danger and thus dispenses with the stationary transformers necessary with the other types of rotary converters. A further great advantage of the motor-dynamo is that in transmission work the frequency may be chosen independent of any consideration of the direct current end of the machine.

The disadvantages of this type are high cost and comparatively low efficiency as compared with the single winding rotary transformer and machines of its class and, ordinarily, the lack of self-starting ability. To start the majority of such machines they must first be driven up to synchronism by using the direct current end as a motor, or by the use of a small auxiliary induction motor.

Notwithstanding the comparatively low efficiency of this type of transformer, its advantages for most classes of work are very great. By careful design and proportioning of its two parts to work well together and by mounting the rotating parts close together on the same shaft, eliminating in this way belt losses, an efficiency of over 85 per cent. at full load may be obtained from machines of moderate size.

From this combination to the composite machine in which the motor and dynamo windings are combined on a single part, generally the rotor, and a single field used, is no great step. An immediate gain in size is assured by the suppression of one field, but many of the desirable features of the motor-dynamo combination are necessarily sacrificed, among them the inde-

[1]M. Georges Dary, one of the editors of "L'Electricien," says of this word: "C'est un terme d'argot parisien qui a été appliqué au hasard, lors de l'invention de cette interessante machine, par un M. Géraldy et qui a été malheureusement adopteé pendant plusieurs années. Ce mot d'argot, qui veut dire 'tout est bouleversé,' 'change dans la génération du courant électrique,' a prés pour racine le mot chahut, chahuter, qui n'est pas français, mais seulement parisien (et de bas étage) et qui veut dire, danser d'une manière, faire du bruit, etc." . . .

(It is a Parisian slang phrase that was applied by chance at the time of the invention of this interesting machine by a M. Géraldy, and which has been, unfortunately, adopted for some years past. The word, which means "all is overthrown," "all is changed in the generation of electric current," has for its root the word chahut, chahuter, which is not French, but solely Parisian, and of low origin, meaning "to dance extravagantly, to make a noise," etc.)

pendence of the alternating and direct currents. Such machines, especially in large sizes, are unsuited to any but the lowest frequencies, their rotation period being a function of the frequency and the number of poles, and high frequencies leading to very complex multipolar constructions or unmanageable speeds with increased hysteresis and other losses. These difficulties have greatly circumscribed the field of usefulness of the composite type of machine and have so far prevented its very extended use. No doubt the superiority of the single-winding rotary transformer has also contributed to the unpopularity of the double winding type.

Discussion of H. H. Cutler's Paper on Motor Regulation and Protection Before the Chicago Electrical Association.

A LARGE attendance of Chicago electrical men was brought out by the announcement that H. H. Cutler would lecture on the above subject, a short time ago. Mr. Cutler having made the matter a special study for the past six years or more and many of his audience being directly interested in the manufacture, design and use of motor regulating and protecting devices, the meeting was one of unusual interest and practical value.

In introducing the subject, Mr. Cutler spoke of the practically unlimited field now opening up for the electric motor in shop transmission, in which field it now has a sure foothold. The regulation and protection of these motors had given rise to what might almost be called a separate branch of electrical engineering. The regulation of an electric motor is always accomplished by reducing the voltage across some part or parts of the windings, according to the nature of the motor and the work to be done. A compound wound motor with provisions on the rheostat for cutting out the series windings and cutting resistance into the shunt field was spoken of as one of the neatest methods. A regulating rheostat of this kind with automatic underload release on all of the various speeds was shown. He also described in detail an elevator controller which relieved the strain on the field insulation when reversing. He advocated, for protection, the enclosed fuse, because it gave the kind of protection that the motor really wanted, namely, protection against overheating, whereas the circuit breaker took no account of the heat being generated in a circuit, but opened whenever the current exceeded a certain amount. Since heat is the thing to be prevented, protective devices operated by heat should be used. The objections made as to the unreliability of the open air fuse did not hold against the enclosed fuse, which always has a definite surrounding medium. He exhibited a new form of circuit breaker of his design which had the magnet coil in shunt with a low resistance. This resistance had a high temperature coefficient and would rise in resistance with an excess of current so as to increase the voltage across the magnet coil and cause it to trip the catch. The value of this form of breaker in motor work lies in the fact that it will permit an overload for a short time, but will never let it remain longer than the safety heating limit of the circuit permits.

F. S. Hickok led the discussion by describing the Waite method of motor speed regulation with which he had occasion to experiment. A peculiar motor was employed having four field poles which were connected so as to make it either a bipolar or multipolar machine—a bipolar when the like poles were adjacent to each other, and a multipolar when the like poles were opposite to each other. The armature had two sets of windings. By altering field and armature combinations a wide range of speed and torque were produced.

F. B. Rae told of certain characteristics he has used in the design of elevator and other motors which must be started with powerful torque, whereby the starting torque is obtained with the expenditure of less current than that used in running at full speed. This is accomplished by enlarging the relative size of the field magnets in a motor until they are worked about at the saturation point to start the load instead of over saturation as is usually the case. The field is then weakened for full speed running. A certain elevator motor so designed by him and working against a constant load with constant torque would start with 24 amperes and consume 34 amperes at full speed.

W. H. Merrill, Jr., speaking from the standpoint of the underwriters, heartily seconded any good words said about enclosed fuses. Not only were they valuable because they confined the arc and were more reliable than the open fuse but they also insured against the danger of getting the wrong kind of a fuse into a fuse block, which was equally important.

He favored an electrical control from an elevator car rather than direct mechanical control, by rope or otherwise. Mr. Cutler thought direct mechanical control the surer and simpler. F. B. Rae described a method of electric control from elevator cars which depended on the Wheatstone bridge principle.

Mr. Cutler, in response to some questions, favored the use of the motor as an electric brake in elevator service rather than some auxiliary electric brake appliance consisting of magnetic clutches and the like. He reasoned that since the motor was already there it might be used as a brake as well as to spend money on other braking apparatus, especially as the motor affords such smooth stops.

ELECTRIC LIGHTING

The Development of the Central Station.—I.[1]

BY SAMUEL INSULL, President Chicago Edison Co.

WHEN requested a short time ago by the chief of the Electrical Department of this University to deliver a lecture on some subject connected with central station work, I must confess to having had some misgivings in accepting the honor to appear before you this evening, remembering the disadvantages that a commercial man invariably feels in discussing technical matters before those having had technical training, but then I remembered that even within my own time (and I think I can still claim to be a young man) very little was known of the general distribution of electrical energy from a central station, and when I recalled that so recently as the early 80's it was necessarily the rule for "guessing to be a substitute for mathematics"(to use the words of the great pioneer in central station work), my misgivings were inclined to disappear, and I felt encouraged to talk to you on the development of the central station from the point of view of my own experience in following this, the latest of the great industrial developments of the wonderful era in which we live.

In referring to the development of the central station, it would seem hardly necessary to go at length into the history of the business, the origin of which probably dates from the work of the early experimenters whose efforts were directed to the perfection of series arc lighting. Whilst their work is entitled to the greatest possible praise, it should be remembered that the theory on which they worked, namely, constant current and varying potential, is a theory foredoomed to failure, when applied to the development of a system of general distribution for light and power purposes, the first essential of which is the necessity for a constant potential the quantity of current varying in accordance with the demands made by those desiring to use the energy, whether for light or power purposes. Nor does it seem to me a matter very pertinent to the present occasion to trace the rival claims as to priority of invention of the early experimenters on incandescent lamps. Which of them was the first to produce a lamp that could be brought to a state of incandescence by means of the electric current is hardly within the scope of our inquiry. Probably all of them, groping in the dark (now and then illumined by flashes of light emitted from their experimental glow lamps), contributed in a more or less degree to the perfection of the incandescnt lamp as now in every-day use; but so far as their contributing much that is substantial, in the development of a system of central station distribution, it is probable that up to the year 1880, there was but one man who realized that in solving the great problem of electrical distribution the perfection of a filament of high resistance, when placed in a hermetically sealed glass globe from which the air had been exhausted and connected in multiple arc across an electric circuit, was the first necessity to the distribution of electric energy in our cities from a central station system.

In Mr. Edison's application for a United States patent on a system of electrical distribution filed at Washington on February 5, 1880, he says:

[1]Through the courtesy of Mr. Insull and of the Purdue University, we are able to present our readers with the text of a lecture delivered on May 17, before the School of Electrical Engineering at Lafayette, Ind. An illustrated edition of the lecture will be published by the University.

"The translating devices for each house may be either for light or power, or both. For light, the electric lamp, consisting of an incandescing material hermetically sealed in glass (shown in other applications made by me) is preferred. This lamp is made of a high resistance in comparison with that of any electric lamps which, to my knowledge, have been proposed. In lights heretofore proposed the endeavor seems to have been to lessen the resistance of the carbon, none having been suggested of higher resistance than, say, 10 ohms; but I have discovered that a very much higher resistance, say 100 ohms, must be used, in order that a number may be economically and successfully used in a system."

The question of the high resistance of the translating device was the first stepping stone to success. Everybody prior to Edison had aimed at getting a low resistance lamp, I presume on the theory that the less the resistance of one the less the resistance of the whole series. He struck out on new lines. A high resistance lamp was naturally followed by a multiple arc system.

In writing of the necessity of a high resistance lamp, the applicant for the patent had in mind that a system of electrical distribution could be used at the same time not only for lighting, but for power purposes, if the motors were properly constructed, and this is evidenced by the next paragraph in his application, which states:

"The motors should be so constructed that each, with a constant flow or pressure of current, will give the exact power required. This requires that each motor should be wound with finer or coarser wire, and into more or less convolutions, which determine the maximum effect of the motor."

If you will search the files of the daily and technical journals, and the proceedings of various scientific societies on both sides of the Atlantic from the summer of 1878 up to and including the year 1882, you will find that the great obstacles in the way of an economical system of central station distribution were the difficulties of producing a lamp that would last, one requiring only a minimum of current, and a system of electrical distribution requiring a minimum of capital, so as to enable electricity to compete with then existing methods of illumination and power.

The lecturer then quoted the opinions of various scientists and experts as to the insuperable difficulties standing in the way of a successful system of subdivision and distribution of the current, and continued:

I personally well remember Sir William Thomson's visit to the Pearl Street station in New York, in 1884, when he saw the Edison feeder system first in operation, and the great interest that he exhibited in studying it, and his admiration for the work accomplished by Mr. Edison in this connection.

I have thought it necessary to thus quote at length some of the leading English authorities in electrical matters, as I thought it would be better in claiming for an American the conception of the true basis of electrical distribution for light and power purposes, to give you the opinion and views on the matter of distribution of our "kith beyond the sea" rather than to quote the views of American scientists who might possibly be considered more impartial to the work of their own countryman.

It is often said that the principles of constant potential multiple arc distribution and the use of feeders to maintain an equal and economical distribution of pressure, are self-evident propositions, following the lines of gas and water distribution; but when you have such high authorities as Conrad Cooke in 1879 failing to recognize any of these necessities, or Mr. Swan in 1880 only recognizing the principles of multiple arc, and in 1882 failing to recognize the importance and far-reaching results of the feeder system, and Dr. Siemens as late as November, 1882, two months after a central station was in operation in New York City, adopting almost the same views as Mr. Swan, you can not wonder at Lord Kelvin answering the question as to why someone else did not invent the feeder system by saying: "The only answer to this, that I can think of, is that no one else was Edison."

It would seem to me, with such authorities, that it is not unreasonable to claim that the development of the central station and distribution system connected therewith dates from Mr. Edison's work at Menlo Park. Mr. Edison had been engaged during the early '70's first as a telegraph operator in the Western Union service, and later working on the gold indicators in the gold room in New street, New York, during the stirring period of speculation in the precious metal which culminated on Black Friday in 1873. Prof. C. C. Law, now connected with the University of Missouri, had, I believe, charge of the indicating instruments, and it is a matter of some interest to record the fact that the first work Mr. Edison did of an inventive character which yielded him a financial return, was in connection with and while he was at work on the gold indicators in question. Subsequently he was employed in the interest of what is now the Western Union Telegraph Company in improving the now universally used stock ticker. This work was followed by brilliant and successful work in connection with the duplex and quadruplex and automatic systems of telegraphy, and the invention of the phonograph and that part of the telephone now generally used for transmitting purposes and known as the carbon transmitter. His attention to the possibilities of what is popularly called the subdivision of the electric light was probably the result of a visit he paid to Mr. William Wallace at Ansonia in the fall of 1878, where he saw some experiments on dynamo machines, and on his return to Menlo Park he started his experiments on a system of electric light and power, which culminated in the successful starting of the first central station, in the lower portion of New York City in September, 1882.

The public interest aroused in his work and the controversy as to whether it was possible for him to achieve anything that would be of commercial value is evidenced by the constant reference to the matter in the public press in 1878, 1879 and 1880 resulting in a panic in gas securities in London in 1878 and in New York in 1879. Probably the work of no inventor was more generally discussed on both sides of the Atlantic by laymen and technical authorities alike than was that of Mr. Edison on his electric lighting and power system. All kinds of comparisons were made as to the difference between the cost of gas and the cost of electricity. It was claimed by many that Mr. Edison could not possibly be considered as having succeeded in his work unless he could produce an illuminant that would compete commercially with gas. They lost sight of the fact that the character of the two illuminants was entirely different, and that there was no more reason for supposing that, if electricity were more expensive than gas, the cost would be a barrier to its use, any more than there is reason for supposing that gas should be considered a commercial failure because the poorest classes find it cheaper to use tallow dips. The probable reason for scientists and electricians doubting the possibility of a successful electric-lighting system being produced was that all previous experimenting on incandescent lamps had been, as I have already stated, aiming at producing a lamp of the lowest possible resistance, and consequently requiring the greatest possible amount of current, these lamps being run in series, whereas Mr. Edison, at a comparatively early stage of his work, realized that the first essential was a lamp of high resistance, and that the only way of approximating an even distribution of pressure was to run these lamps in multiple arc. Hence his application for a patent on a lamp with a high resistance filament, under date of November 4, 1879, and his application on multiple arc distribution in February, 1880. It was then but a short time before he realized that, although experimentally this might give him even pressure, the expense of the copper in his distribution system would be too great, owing to the necessity of increasing the size of his copper, as he got farther and farther from the point of generation. The result was that in August, 1880, he applied for his patent on a system of feeders to supply his system of mains at various points throughout the system, the effect being a compact system with current flowing in all directions from the central point of generation through feeders, by means of which even pressure could be maintained throughout a considerable area.

A still further step made by Mr. Edison was the realization that nothing very reliable in the way of a distribution system in large cities could be maintained unless the work was placed underground, and, as a result of his work of a little over two years, we find that in the early winter of 1880, Edison had a central station system experimentally at work at Menlo Park, N. J., having an underground two-wire system, with the homes of himself and his staff electrically illumined by incandescent lamps, motors at work in his laboratory, and, in fact, all of the essential features of what is to-day now so common from the largest cities to the smallest villages throughout the whole civilized world.

It was but a short time after the starting of the first central station, in New York, that Mr. Edison found himself looking for some more economical methods of distribution; and I well remember his first experiments on the three-wire system, when,

at his shop in Goerck street, New York, he placed a third brush on the neutral point of the commutator of a small bipolar Edison dynamo and demonstrated the practicability of the three-wire system.

At the same time that Edison was working on the three-wire system experimentally in New York, Dr. John Hopkinson was probably figuring out the same thing in England, and Werner von Siemens was engaged in similar work in Germany. The records of the United States, English, and German patent offices bear witness to the fact that these three men accomplished about the same results at about the same time, and as a consequence, between 60 and 70 per cent of the investment in copper was saved.

New Large General Electric 60-Cycle Rotary Converter.

IN the station of the Pennsylvania Heat, Light and Power Company, Philadelphia, Pa., has recently been installed by the General Electric Company the largest 60 cycle rotary converter yet constructed. It is a 16-pole machine, of 400 k. w. capacity, running at 450 revolutions per minute, and was designed to convert an alternating two phase current of 60 cycles frequency and voltage variable between 165 and 220 volts, into a continuous current at from 225 to 300 volts. It is designated QC 16-400-450 and stands 8 feet high on a base 8′ 4″ by 8′ 6″.

The field frame of this machine (Fig. 1) is heavily ribbed, divided horizontally and susceptible of movement along the base to allow of inspection of the armature and field coils. The bearings are extra long and of the General Electric self oiling and self aligning type, that at the commutator end of the shaft being provided with an end play device to keep the armature in constant motion in the direction of the length of the shaft and distribute the wear of the brushes over the commutator surface to avoid the wearing of grooves. The armature is of the ironclad type.

The commutator carried on a separate spider is of very ample surface, and has a large number of segments. To facilitate the removal of a brush for examination and replacement without varying the tension under which it runs, a brush holder of unique design has been devised. To remove the brush the prolonged end of the brush holder is disengaged from the brush holder by a slight end motion.

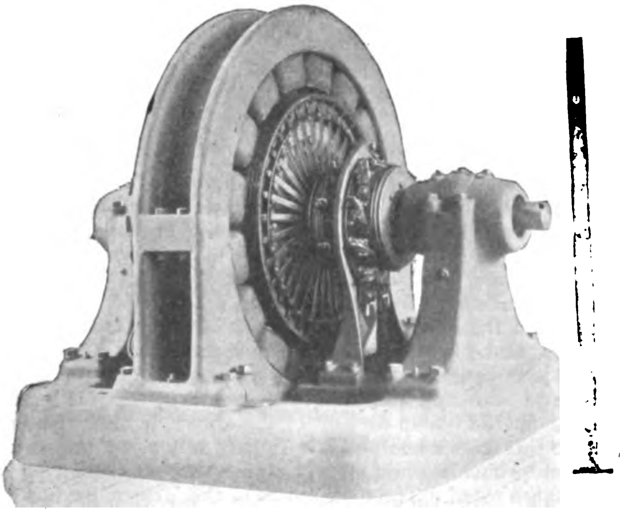


FIG. 1.—G. E. 60 CYCLE ROTARY CONVERTER.

Another valuable feature in this machine is the design of the brush holder studs and the method of attaching them to the yoke. The former instead of passing through insulating bushings in the yoke—as has been customary in this type of machine—is provided with a lug bored to fit down upon a radial stud held by bolts passing through the insulating bushings. To slide the brush holder stud off, it is simply necessary to loosen the nuts on the bolts passing through the bushings. By employing this method, all labor and expenditure of time usually consumed in removing the insulating bushings and washers from the brush holder yoke to remove the stud are avoided, and the change can be effected in a very few minutes. Fig. 1 shows the two phase side of the converter. Upon the collector rings press numerous leaf brushes, having a long contact on the rings, and a very large current carrying capacity.

To obtain the necessary variation in the continuous current of the rotary converter the General Electric Company have furnished with it two special 60-cycle transformers each of 220 k. w. capacity (Fig. 2.) These have been designed to operate with a primary potential of 2,000 volts, and a secondary potential varying from 165 to 220 volts. The variation is obtained through a dial switch over which passes a contact plate cutting out or throwing in, more or less turns of the primary winding and thereby varying the secondary potential. The switch is

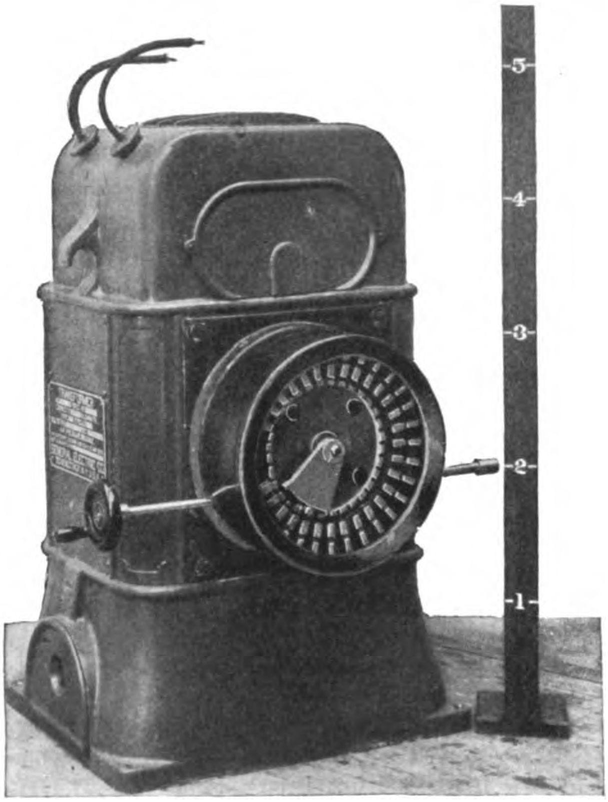


FIG. 2.—G. E. 60 CYCLE TRANSFORMER.

operated by a wheel handle, and the potential may be varied rapidly in either direction, the contact plate snapping from contact to contact in one direction as well as in the other. The dial switch is applied to the transformer itself instead of being a separate device, and the entire construction is singularly compact.

The rotary converter before shipment was subjected to a more than usually severe test. It is now operating satisfactorily in the station, running under heavy loads without sparking or cutting at either the commutator or collector rings.

ELECTRIC HEADLIGHTS. In some of the States the Railroad Commissioners appear to be urging the equipment of locomotives with electric headlights, because "they will save more property and lives each year than all the other safety appliances combined."

FIFE, SCOTLAND. From Fife comes the news that a communistic gin mill makes a yearly profit of £500 in a Fifeshire village of twelve hundred inhabitants. With part of these profits the villagers are equipped with reading and recreation rooms, and they now propose to light the village with electricity and put electric lights in every house at half what it costs.

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An Object Lesson for Municipal Plant Advocates.

IT is now about ten years ago that the then Mayor Grant of New York ordered the electric light poles in this city to be hacked down with axes and the wire carted to the city junk yard. This policy of violence was the first step toward the placing of the wires underground, and although no one would now go back to overhead wires the method adopted for bringing about the result will always be considered to have been arbitrary and uncalled for. In striking contrast with the New York ex-Mayor's procedure is the painstaking and intelligent manner in which the officials of Providence, R. I., have gone about adjusting questions of this kind with the local lighting contractors, the Narragansett Electric Lighting Co. The latter company has an exclusive franchise for electric lighting in the city, but instead of abusing its privilege, has steadily increased its hold on the public confidence by its policy of fair dealing, emphasized by a steady reduction in rates. Recently a committee of the City Council was appointed to report upon the placing of high tension wires underground, and the committee's report now lies before us. Before formulating its report the committee undertook a trip of inspection of underground work in various cities, and that it was not a junket is evident from the fact that the committee traveled at its own expense. The proposition which it sanctions for adoption by the City Council is substantially that submitted by the electric lighting company. This contract provides for the gradual removal within three years of all the overhead wires and their placing in underground conduits within what is termed the first building district of the city. At the same time the lighting company agrees to a gradual reduction of the price for lighting from 35 cents to 30 cents, to take effect in 1903, for 2,000 c. p. arc lights burning 4,000 hours per year. Considering the expense which the burying of the wires will entail the rate just quoted will be conceded to be eminently low—one, indeed, that will require the highest economy in all departments of station work. But President Perry, of the Narragansett Co., has always had a reputation for wanting the best that money can procure, and we doubt not that under his management the company will, as heretofore, remain among the most substantial electric lighting properties in the country. At the same time we must express our gratification in these days of municipal ownership agitation that the City Council of Providence has among its members men who are sufficiently intelligent and patriotic to weigh and determine the questions submitted to them in a spirit of fairness to the interests both of their constituents and of their lighting contractors. We feel certain that if every city in the Union had adopted the arrangement entered into by the city of Providence and the Narragansett Electric Lighting Co., by which the latter is limited to a profit of 8 per cent. on its share capital, in lieu of the grant to it of an exclusive franchise, very little would be now heard of municipal ownership of electric lighting plants in this country.

Motormen and Car Control.

THE electric railway has stood during its brief existence of ten years, more than its just share of public abuse and denunciation. At first it was the unsightly and deadly trolley, then the inadequate and offensive storage battery, and now we hear the cry against the poor design or management of the controller. This phase of the subject and the injury done to the public was recently discussed editorially in the New York "Herald." After crediting the cable cars with a slight improvement in their starting and stopping, the article continues:

"But the electric cars have now taken up the running, and they surpass the wildest vagaries of their cable prototypes. Their motormen are not satisfied with one violent jerk. They give us two and sometimes three as they start. Between the step of the car and the seat on which the exhausted passenger is finally flung there is no safety or refuge. Men and women are tossed into each other's arms and laps with constant injury to clothes, to the human frame in general, and to the nervous system in particular. The journey from the Post Office to Harlem is rather more dangerous than if the Spaniards lay in wait for the travelers. Whether these systematic jerks are due in part to an imperfect equipment or wholly to the unskilfulness of the motormen they are equally dangerous and disagreeable. It is quite time for the company to say whether they propose to give us a better service."

To say that the above criticism is uncalled for would be inconsistent with facts, for it is true that the sudden jerks in stopping and starting the cars are altogether too frequent and extremely annoying. It only remains to fix the blame and suggest remedies for this public nuisance. To the electrical engineer who has carefully watched the gradual development of the electric car and the labor, money and care which has been expended on each detail, nothing would seem as absurd as to place the blame of the nuisance on the electrical or mechanical equipment. The body of the car itself is a model of mechanical skill, well balanced and proportioned. The truck has received careful attention from well known engineers, car wheels and track construction have been brought well nigh to perfection, and much care has been bestowed on the braking mechanism. The electric motor has gone through many stages of development, until now it has reached a point of perfection seldom attained in machinery as heavy and as much tried. Motor suspension and the driving mechanism have been carefully studied problems, and the methods of suspension used at present, as well as the single reduction method of connection make it possible to start and stop a car without a jar or jolt. Having failed to fix the blame on any of the above, it only remains to examine into two more possible causes, which, by the way, are the most probable ones namely, the speed controller and the motorman himself. The mechanism of the former, having reference to the series parallel controller, which is the one in use on the roads in question, has been specially designed with a view of insuring perfect flexibility of operation. The motors, which are connected in series when the car is at rest, are gradually by nine successive steps changed to a parallel connection, by which time the car has attained its maximum acceleration by apparently insensible gradations. Each step in the transaction has its specific purpose, and it is the neglect of the motorman to allow the full effect of each step to exert itself, which causes the disagreeable and avoidable shock to the passengers. This is due either to the lack of training of the motorman or his endeavor to make schedule time. The same causes are responsible for a city electric road requiring from 15 to 25 per cent. more energy to operate it than would be required were all the motor-

men to handle their controllers carefully and intelligently, with a view to using as little current as possible without getting behind time. The efficiency of the series combination at the start is totally destroyed by the rapid turning on of the power, and the armatures are overloaded by cutting in the field shunts too soon. One remedy for this has already been suggested by Mr. J. R. Cravath, in the use of his "excessive current recorder," described in The Electrical Engineer, January 20, 1898, which is designed to furnish an electric railway management with the knowledge of the excessive use of current by various motormen without interfering with the operation of the road. While thus insuring the management against an uneconomical use of the current, the public is equally benefited by the correct use of the controller. But it appears as if simpler remedies than the above could be devised, namely, the correct training of motormen and the fixing of a schedule which permits the men to use the necessary care and discretion in the starting and stopping of the cars.

Cutting the Manila Cable.

OUR recent remarks on the importance of having competent marine electricians on board a fleet that is likely to have cable cutting to do or wants to use cables after they are cut, find confirmation in the reports that arrive from the Philippine Islands. Just what the rights of the cable companies are, nobody knows exactly, despite the rules and regulations that have been drawn up and recognized as a code. But whatever those rights may be, it is certain that in time of war, a country like the United States would not allow a cable to be long used as a means of offence or attack against it, and that is just what happened at Manila, when the Spaniards, controlling a cable owned by neutrals, would not allow our fleet access to it. We thereupon cut the cable, doing just the right thing; but as our fleet had no operators and the Spaniards would not permit the use of any from the island or of apparatus, there was a deadlock, which nothing can relieve until this country is as fully master ashore as it is afloat, in the Philippines. In this connection we may quote the comments of the London "Electrical Review": "In any case, the importance, from a practical point of view, of equipping every war vessel with the simple apparatus necessary for establishing communication through a cable, when need be, is more than evident. With the old marine galvanometer no readable signals could be obtained, but the Sullivan galvanometer, now used in our Navy, is adapted for both testing and signalling purposes, and with but a little practice, naval men should become expert in exchanging messages through cables, whenever the occasion may arise. We believe our war ships now have the means for grappling cables in shallow or moderate depths of water, as well as suitable electrical apparatus."

If this be the case, our own ships should be similarly equipped, and the need in Cuban waters to-day for good marine electricians is as great as in the Far East. This is one of the things that must be seen to.

The Advisability of Frequent Reinspection.

THE recent fire at the Union League Club, Chicago, caused by the crossing of electric light and annunciator wires and the deterioration of the insulation of both wires by moisture, is to be sincerely regretted, and is another reminder of the absolute necessity of frequent inspection and reinspection of electric installations. It would certainly seem as if the new "National Code," which is the result of the united efforts of the various electrical, insurance, architectural and allied interests, would be a safeguard against such calamities, if the rules and requirements laid down therein were closely followed by the companies installing electrical apparatus, and were enforced by the boards of fire underwriters and inspectors.

In view of the danger involved and the severe punishment imposed for the violation of these rules, we may without reserve express the opinion that the regulations are generally adhered to and that the frequent fires are caused by the superficial and uninspected work done, or repairs made after an installation has been completed. This, as well as the destruction of the insulation of wires due to abrasion or other mechanical injury or the disastrous effect of the slightest presence of moisture, at once suggest the necessity of frequent reinspection of electrical installations. One need not seek far in our own city for reckless examples of provisional wiring, installed by men who apparently did not fear or expect a reinspection of the installation. It would be well for the Board of Fire Underwriters to look into this matter and appoint a staff of reinspection, whose duty it shall be to see that no new wiring of whatever nature is installed anywhere unless it conforms in every particular with the rules and regulations contained in the "National Electrical Code." Such measures as are now in force appear inadequate.

The Electric Railway Controller and Motor Suspension Decisions.

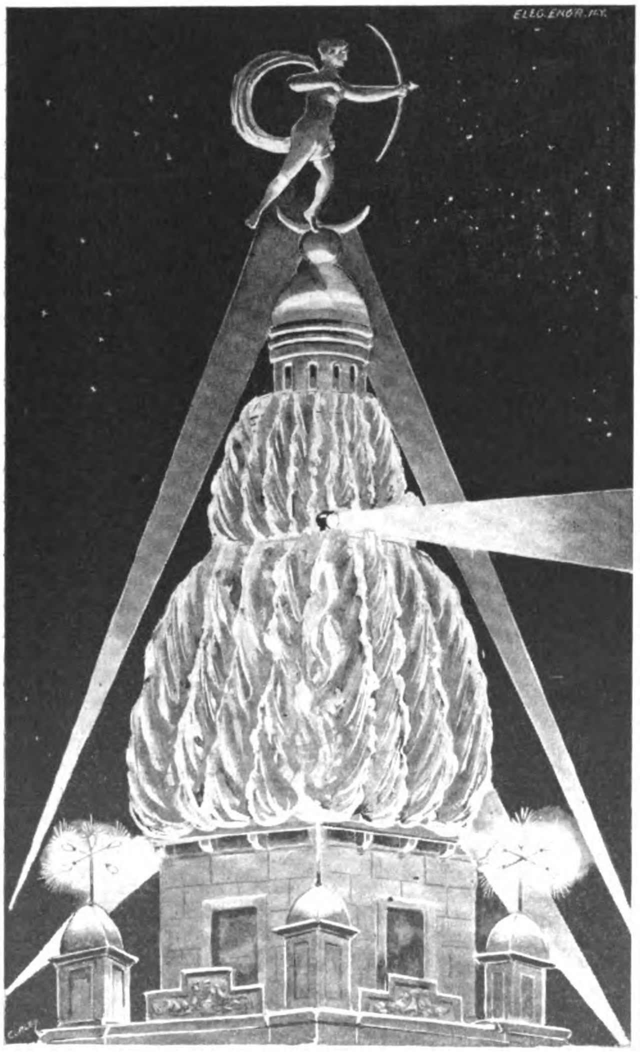
LAST week we announced that the Edison compound winding patent had been declared void by the courts, and called attention to the fact that this was another of the series of so-called controlling patents which had gone the way of everything earthly. But that conclusions ought not to be drawn too hastily as to the true value of existing patents in the art is manifest from two decisions just rendered which promise to have an important effect upon the electric railway industries. One of them sustains the broad claims upon the series parallel controller, and the other sustains claims covering the spring suspension of motors centered upon and geared to the car axles.

The two fundamentals of electric car propulsion are the electric motors and the electric controllers. Practical development has discarded all methods of control other than that known as the "series parallel." This involves, however, something further than the mere idea of coupling the motors in series when starting and in parallel when running at full speed. That suggestion entered early into the field, but was abandoned for the difficulties attendant upon the heavy electrical discharges and inertias of current which accompanied a change from one relation of circuits to the other were so great as to be regarded as insurmountable. The wasteful rheostatic method, therefore, remained in use until Mr. Condict, working in the storage battery fields of traction, came forward with his solution of the difficulties. His plan involved the use of "dead" resistances which could be introduced gradually into the circuit before a change in the circuit connections from series to parallel or from parallel to series and are then gradually cut out of circuit. There are thus two uses of the dead resistances; first, the protecting use at the time of shifting the circuit connections, and, second, the temporary use of supplementary resistances at times when it is not necessary to make changes in the circuit-connections, but it is desired to obtain minor gradations of speed. When it is considered that this method of control has superseded all others, that it is regarded as absolutely essential, and that every modern electric car controller is now built upon this principle, the rendering of Judge Townsend's decision awarding the merit of its discovery to Mr. Condict is a compliment of which any inventor might be justly proud.

The decision of the Circuit Court of Appeals on the spring suspension of electric motors is another important factor in the future of electric railroading. All manufacturers of electric railway motors have thus far found it necessary to flexibly support one end of the motor and to sleeve the other end upon the axle of the car. This was as true of the old double reduction motors as it is of the present single reduction motor. Thus far at least no other way of supporting motors appears to have been found practical. Although the effect of these two decisions may be somewhat severe, it must nevertheless be encouraging to the developers of electrical arts to know that it is possible to sustain good patents. As the patent laws are primarily designed to encourage invention, it is a matter for congratulation whenever an original inventor has the satisfaction of having his patent sustained.

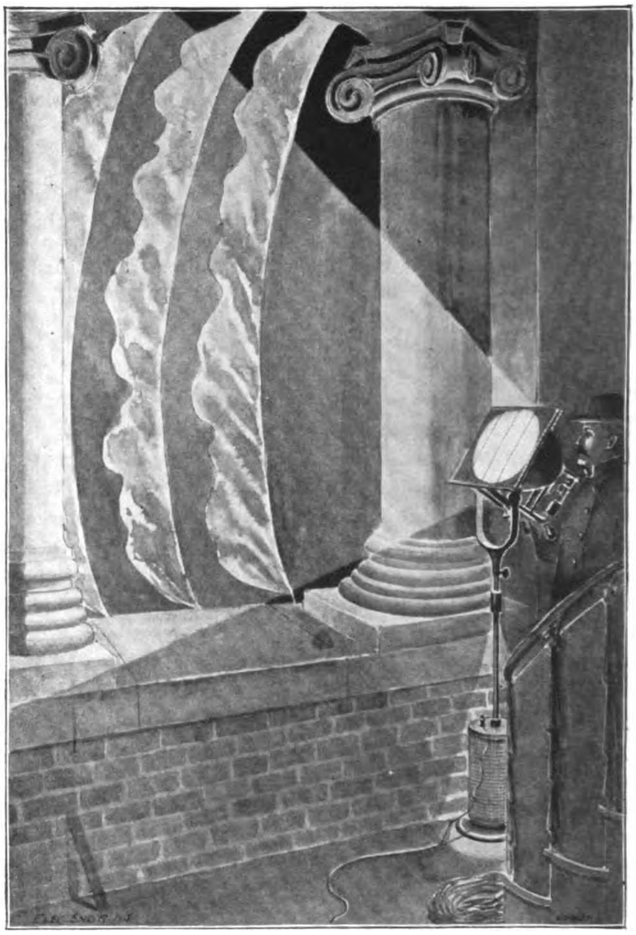
The Lighting of the Madison Square Tower.

FAR reaching as the educational and commercial influence of the second Electrical Exhibition is, and lasting as the impression will be which it has made on the minds of those who have seen its numerous magnificent displays and special features, the illumination of the tower of Madison Square Garden will probably be longer remembered by the citizens of Greater New York as a whole. Never in the history of the Garden has its exterior presented so gorgeous an appearance as it has during this time. The tower, which is in itself a model of architectural design, has for this occasion been so enhanced by means of electrical light effects, that it has become one of the features of New York at night. The goddess Diana, heretofore hidden from view after sunset, now becomes visible at night. The effect produced by the multi-colored beams from fourteen searchlights behind a mass of very thin white silk gauze is beyond description, and unless our readers are fortunate enough to see the beautiful display, we again refer them to an account published in the "Evening Post," and reprinted in our issue of May 12. This short sketch, however, left the reader without a knowledge of the means employed to produce these effects, and a few of the technical details will certainly be of interest.



THE TOWER OF MADISON SQUARE GARDEN, SHOWING ELECTRICAL DECORATIONS.

The upper three tiers of the tower, which is shown in the illustrations, were covered with about 2,000 yards of very thin, silky material, of the same nature as that used by Loie Fuller in her celebrated skirt dance. The gauze is fastened to the tower, from tier to tier, in vertical columns, each one yard in width, the halyards on which they are mounted being loosely strung between the columns supporting the tier above. Surrounding the lower tier, which is 30 feet in height, there are thirty of these strips; around the middle tier, which is 25 feet high, there are twenty-four strips, and eighteen of them surround the upper tier, which is 15 feet in height. Behind this mass of delicate gauze, which stands out in graceful undulating curves when swayed by the wind, are placed eight Ziegler stage lamps with colored screens, the color for each tier being different. These lamps, which are in charge of stage lighting experts, are specially well adapted for this work, on account of the right angled arrangement of the carbons. The reason for this is obvious, for it is well known that the light is projected from the positive carbon, which in this case points directly at the object to be illuminated. These lamps throw their light directly behind the gauze, while six more similar lamps stationed on the parapet below add to the effect by throwing their colored rays obliquely against the lower folds of the fluttering material. The current is led up to the tower by three large feeders of the Edison three-wire system, and when all the lights are in operation a current of about 300 amperes is used. It is said that the radiant effect is clearly visible at a distance of many miles from New York city in every direction.



THROWING COLORED PROJECTION BEAM ON DRAPERY FROM WITHIN THE TOWER.

WAR NEWS.—The announcement of news from the seat of war which has now become a regular feature of the Show is being highly appreciated by the large number of visitors. The bulletins are thrown on a large screen in the Main Hall and Concert Hall as soon as they are received from the most authentic sources.

General Notes of the Exhibition.

The past week at the Electrical Exhibition has been marked by a steady maintenance of the popular interest. In fact, it has been surprising to see how large the crowds are on wet nights, which unfortunately have been much more numerous than the fine ones. On fine evenings the Show is sure to be thronged in every quarter, and the utmost interest is taken in every feature, whether of mere novelty or for educational purposes. The Moore Chapel has always its long waiting line, the crowds around the wax tableaux are often five and six deep; the explosion of mines in the tank draws without fail, while all the other fifty features are constant centres of attraction.

During the past week an exhibit of unusual interest was added in the Assembly Rooms, adjoining the other relics and curios. It has been loaned by Mr. Daniel Davis, of Phillipsburg, N. J., and embodies some of the work of his modest but talented father, such as the very rare book that he wrote on electricity and magnetism. The chief features of this special exhibit are the early examples of electro-deposition in gold and copper. One of these is of a little child's arm, taken fifty years ago, and probably the very first instance of electroplating the human body. There are also examples of japonica leaves, buds, etc., and a portrait in electro-deposition of Daniel Davis himself. One very interesting exhibit is that of a gold medal awarded in 1847 to him for his electrical instruments by the Massachusetts Charitable Mechanics' Association. Being "hard up" and really in need of food, as the result of his zeal in experimenting, he took casts of the medal, used the medal itself for plating the two shells, filled the inside with wax, and preserved this electrotype, meantime using the real medal, which he melted down, as a means of providing bread and further resources for investigation.

During the present week all the regular features of the Exhibition will be maintained in full swing. On Thursday an important lecture will be delivered in the Concert Hall before the New York Electrical Society by Prof. S. H. Short. This well known engineer will speak on "Heavy Electric Traction," and the lecture will be illustrated by lantern slides and the projectoscope. The following night, the Society will celebrate its recent work and the election of its new officers by a dinner at the St. Denis Hotel, Broadway, at 7:30 p. m.

The influx of children to the Show during the past fortnight has been very notable, and is an excellent thing, both for the Exhibition and for the rising generation.

Exhibit of the Edison Electric Illuminating Company.

THE exhibit of the Edison Electric Illuminating Co., of New York, occupies, in three sections, the first of the larger spaces on the main floor, containing about 800 square feet to the right of the main entrance. Within a spacious and highly artistic Grecian temple, surmounted by a dome brilliantly illuminated by 4,000 miniature incandescent lamps, are shown the more important and novel applications of electricity to industrial and household purposes. In the central section, beneath the dome, which is devoted to electric lighting, are shown miniature and candelabra lamps, ranging from 1 to 8 c. p.; standard lamps from 8 to 100 c. p.; reflected ceiling lighting, the lamps being concealed from view; the new English reflector lamps, which will soon be introduced into this country; sign lighting and advertising designs, as shown by the lettering around the upper portion of the temple; artistic decoration and variation effects illustrated by the beautifully lighted dome. In arc lighting are shown enclosed arc lamps of the Bergmann, General Electric, MacIntire, Pioneer, Ajax, Bijou, and Standard types, ranging from 400 to 2,000 c. p., and burning continuously with one trimming of carbons, from 100 to 150 hours; Colt projectors, for photographic and stage purposes, throwing varied colored beams of light around the exhibition hall. Under supported lamps, feeding from below, very suitable for post and doorway lighting, are also shown. Very artistic MacIntire post lamps guard the entrances to the booth. A Thomson meter is connected to a bank of lamps and the attendants take special pride in showing how this splendidly balanced instrument registers accurately the current consumed by one single lamp. There is also exhibited a box containing several sections of feeders such as are laid down by the company in the streets of New York.

The end section of the exhibit, nearest the entrance, is devoted entirely to electric heating and cooking, the numerous devices being in actual operation. There are shown in this space the cooking devices manufactured by the American Electric Heating Corporation, such as electric ovens, chafing dishes, farina boilers, tea kettles, coffee pots, egg boilers, heating coils, coffee and hot water urns, as well as irons for boudoir as well as heavy tailoring work, soldering irons, an apparatus for vulcanizing patches on bicycle tires, curling irons, foot warmers and radiators. A picture of the Edison Co.'s celebrated electric kitchen is also shown. This kitchen has in its entirety been transported lately to Sandy Hook, where it is supplying the electrical corps with food far daintier and certainly better prepared than the rations dealt out to other defenders of our coasts and harbors.

The third section of this magnificent exhibit is devoted to power, largely "direct connected." Here are shown a printing press direct connected by friction pulleys to a G. E. motor; and a rotary printing press driven by a Crocker-Wheeler slow speed motor placed under the table carrying the press. This press prints, cuts and delivers 36,000 to 60,000 copies an hour. There are also a Morrison direct connected book binder; a drill press with Crocker-Wheeler motor; an ironclad motor connected by means of a long flexible shaft to a drill press; a Lundell motor

THE NEW YORK EDISON CO.'S EXHIBIT.

direct connected to a Quimby rotary pump, controlled by a Zimdars & Hunt switch; Singer sewing machines driven by self-contained Diehl motors; and a stereotyping outfit for meteorological work. A new refrigerating plant, built by the Hygienic Refrigerating Co., operated by a C & C motor, shows the actual freezing of water and does work equivalent to the making of 500 pounds of ice per day at a cost not exceeding the prevailing price of ice. Besides these exhibits at the booth, this company, which is by far the largest and most successful electricity supply company in the world, has placed around the main hall several arc lamp posts such as they have installed in several New York streets and avenues. They also supply current for the lighting of the building and that used for the vacuum tube lighting in Moore's Chapel.

A description of this enterprising company's exhibit would be incomplete without the mention of the following entertaining and instructive features which have made this booth a Mecca for the visitors of the Show. All cooking apparatus is in working order, and tea and biscuits are freely served to all by Mrs. Helen Hyde and her numerous assistants. The printing presses are at work turning out war dispatches received in the company's booth by special telephone arrangements. A beautiful self-playing piano is sending out its melodious strains and invites all to come hither and partake of the hospitality of the Edison Company, ably represented by such well known engineers as Messrs. Arthur Williams, John van Vleck and J. W. Lieb, Jr., assisted by Messrs. W. D. White, D. Burnett, C. A. Littlefield, H. D. Betts, and W. D. Brown. The entire exhibit was authorized by Vice-President R. R. Bowker before his departure for Europe, and reflects great credit on all who have shared in the carrying out of the project.

The Bullock Electric Mfg. Co.'s Exhibit.

THE Bullock Electric Manufacturing Company, occupying an attractive booth on the right hand side of the centre aisle, have one of the first exhibits noticeable upon entering the hall. The display consists of one 25 k. w., 125 volt slow speed direct driven generator; one 25 k. w., 125 volt moderate speed belted generator; one 7½ h. p. moderate speed open motor, and one 10 h. p. slow speed enclosed motor.

The direct driven generator is receiving unusual attention. The perfect symmetry, finished details and compactness of form attract the eye, and the many peculiar points of construction hold the attention for deeper investigation.

Of the various claims of the company for the apparatus here shown may be mentioned the extreme stiffness of field obtained by an original construction of the field poles. These field poles are built of very thin laminations of soft iron, in such a way that the pole face contains but one-half as much iron as the pole proper. By this means a strong density is obtained where the lines of force enter the armature, accomplishing the same result as would a wide and dense air gap, with a considerable saving in current required for excitation. By virtue of this stiff field, field distortion is reduced to a minimum. The thin laminations completely break up eddy currents. By thus ridding the fields of the choking action of these eddy currents when the compound coil is producing this effect an extremely quick acting field is obtained. The field coils are separated, allowing perfect ventilation, and being wound upon separate forms, are readily removable.

The enclosed motor represents the latest practice in this kind of machinery. It is thoroughly protected from dirt and water, and is so constructed that by removing the small cover the commutator may be inspected.

Mounted upon a board in the rear of the booth is one of the company's type "T" controllers wired to this motor. Although this controller is remarkably small, it permits six different speeds in forward or reverse direction, and also operates an electric brake, by means of which the motor can be brought to immediate rest, from full speed. With this controller the armature can be moved inch by inch—a valuable point when running certain kinds of machinery. The Bullock exhibit is noticeable for its neat arrangement, and the prominence which is given to the essential features of the machinery. It should be added that the John Thomson platen press used on the opening night, and since then doing splendid work with fine half tones, in circulars for distribution, is operated by a direct connected Bullock motor.

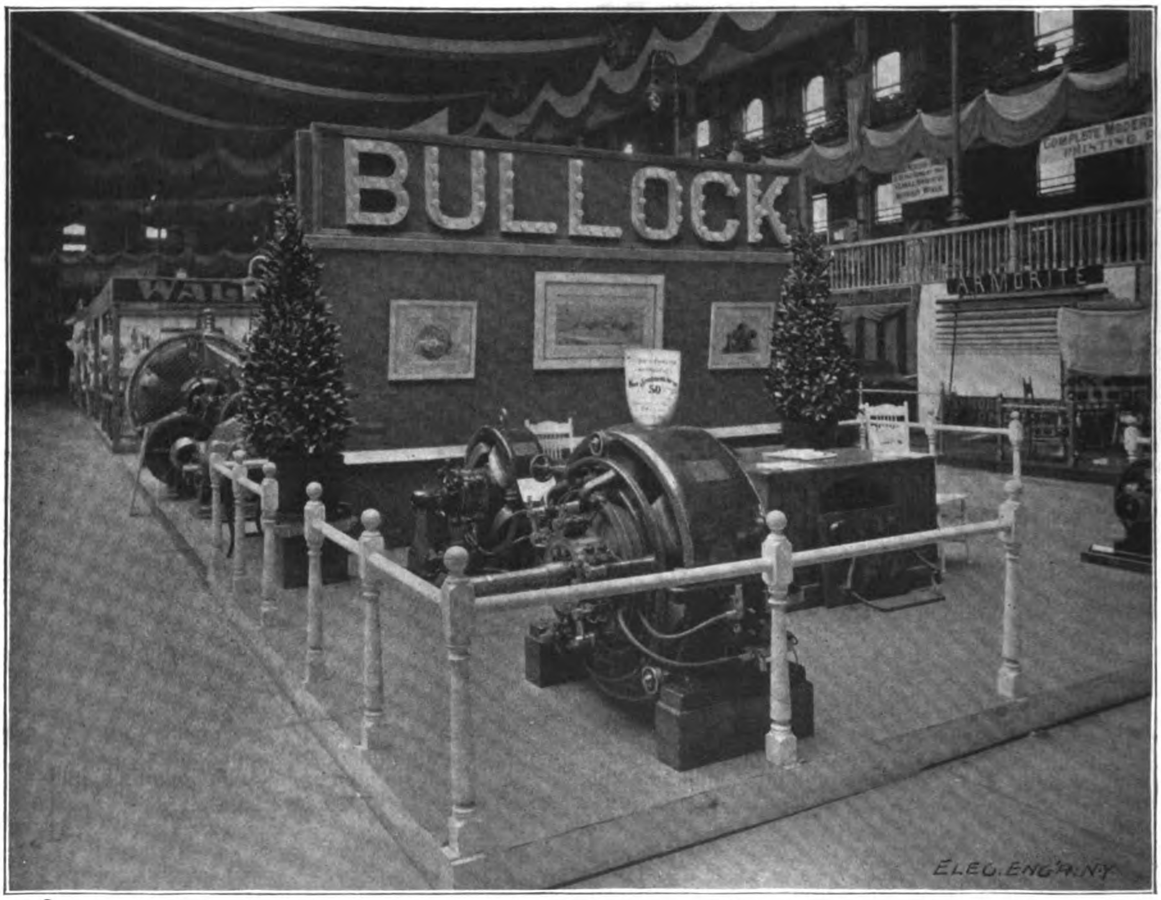


EXHIBIT OF THE BULLOCK ELEC. MFG. CO., MAIN FLOOR.

The Pope Mfg. Company's Columbia Electric Carriage Exhibit.

ONE of the most striking indications of the rapid advance taking place in electrical engineering is the development of the electric automobile road carriage. The Electrical Exhibition at Madison Square Garden, New York City, offers a very strong illustration of the fact. The opportunity to observe this new branch of electrical transportation is an exceptional one.

In the exhibit of the Pope Manufacturing Company, what is probably the very latest development in this branch of electrical engineering is shown in the form of a "Columbia Carriage Mark IV," as it is termed. This vehicle consists of a very elegant appearing double-seated road carriage. It is large enough to carry four people very comfortably, and six people without discomfort. The illustration given shows the general style of vehicle.

Its electrical equipment consists of 42 cells of storage battery capable of very high discharge rates, and the general abuse that traction batteries are called upon to stand. A novel feature of these batteries is the fact that there are three positive plates and two negative plates in each cell. The positive plates are of a Planté formation and are made extremely porous, so that a certain amount of the active material on the outside surface is available. The 42 cells are arranged in six similar boxes, seven cells being sealed in each box. The total weight of the battery is

1,500 pounds, and its capacity at a 40 ampere rate of discharge is 120 ampere hours. This is sufficient to drive the completed carriage with five occupants thirty miles on fair roads, and more on good roads, at an average speed of ten miles per hour. The vehicle complete, ready for service, weighs 3,000 pounds.

While the exhaustive tests that the Pope Manufacturing Company carried out before their selection of a storage battery indicated that a much lighter battery could be produced which would give the same work as the one in the carriage, yet no such battery would be practicable in the hard, every-day service in which these carriages are intended to operate. It is claimed to have been the aim in the designing of the electrical equipment for this vehicle to strike a conservative compromise between a commercially practicable length of life and the least possible weight. From the figures given, it certainly seems that this compromise has been judiciously taken.

The carriage is fitted with a specially designed controller for the duty in hand, which groups the six boxes of batteries in three different groups, giving three different voltages. The motors are wound and the gearing arranged so that these different voltages give the following speeds: 2¾, 5½, and 11 miles per hour. The operation of the controller is, of course, very

HORSELESS CARRIAGE EXHIBIT OF THE POPE MFG. CO.

similar to that on an electric street car, except that it is much more convenient to the operator, enabling him to give his principal attention to the guiding or steering of the vehicle. The controller is operated by a fore and aft moving lever grasped by the left hand. The notches are very distinctly felt, and the question of speed control seems to be perfectly met in every particular.

The principal feature that strikes the electrical railroad engineer in the motor equipment is the similarity between it and the approved street railway construction, except in the matter of motor suspension. No spring is provided. The motors are rigidly fast to the running gear of the vehicle and geared to the driving wheels through single reduction gearing. The makers of the carriage have found that with the pneumatic tires which they use there is no necessity for a spring suspended motor. The tires annul all the shocks from the road, and as is evident by the condition of the commutator in a carriage which has been operated continuously for over a thousand miles, the controller seems to provide for the shocks of starting.

Unlike a street car, however, it is necessary on a road carriage which is fitted with rubber tires to provide for the outside wheel turning faster than the inside wheel when turning corners. This is accomplished very happily by the providing of two motors, one for each driving wheel. The difficulty of overloading the motor driving the inside wheel is overcome very ingeniously by so arranging the connections that the armatures are always in series. In some cases where particular graduations of speed are required, the motor fields are coupled in numerous combinations of series and parallel, but the armatures are invariably in series. This, of course, solves the problem of turning corners, as far as overloading the armatures goes. The carriage is enabled to start from a standstill in a very muddy road with the steering wheels cramped to their maximum without any difficulty being experienced in current consumption or sparking at the commutators.

The Pope Manufacturing Company reports that one of the most difficult problems in the development of the electrical road carriage for popular use was getting a battery which would stand the abuse that the untechnical public seem unable to avoid occasioning. The principal abuse is what is called "starving" the batteries, or not putting back into them as much current as has been taken out.

To overcome this, an ingenious system of electrical measurement has been developed. It consists principally in a specially designed recording wattmeter. The current passing out of the batteries and into the motors when running the carriage passes through this wattmeter and causes it to register accurately in watt hours. When the carriage battery is re-charged, the connections are such that this wattmeter runs in a backward direction, or as it may be termed, returns toward the "Full" position. It runs, however, at a slower rate when the batteries are being re-charged and therefore does not arrive back at the full position until a certain excess in ampere hours over what was taken out has been returned to the batteries. This excess, of course, provides for the losses occurring in the battery. The meter is, furthermore, provided with a small cut-out device so that when the recording finger reaches the position known as "Full," the main switch of the carriage is automatically thrown, thus cutting out the charging current. The purchaser thus has the charging of the batteries taken entirely out of his hands. When he makes the necessary connections through a regular charging plug and cable that are furnished with the carriages and closes his charging switch, there is absolutely nothing more for him to do until the batteries are full.

"Starving" the batteries is thus very successfully avoided and all of the numerous troubles following upon failure to immediately re-charge after a long, severe discharge are overcome. The excess returned to the batteries is enough to provide for the necessary de-sulphating and losses that take place from slight and unavoidable inter-cell leakage.

Another interesting feature from an electrical standpoint in these vehicles is what is termed the "running plug." It consists of a small aluminum, specially shaped plug which is inserted in the main circuit which is led up to the seat convenient to the left hand of the operator. The removal of this plug prevents the carriage from being started, and also provides an immediate switch in the event of the remote possibility of anything happening to the controller preventing it being returned to the "Stopped" position.

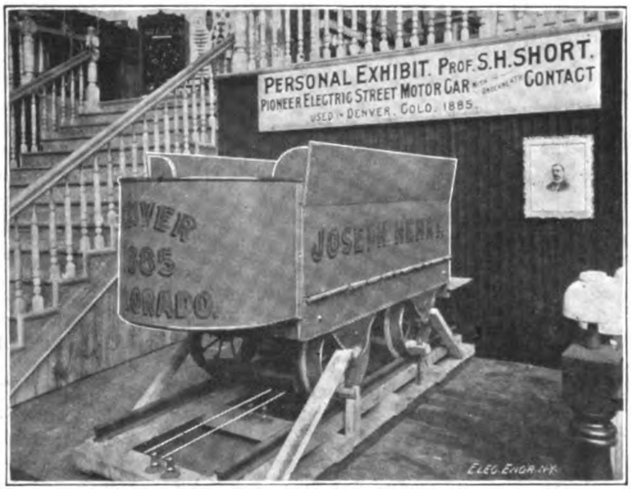
The brake is a most powerful one and consists of two metallic bands surrounding pulleys arranged on the armature shaft. A very light application upon the foot-pad exerts a very strong retarding effect. An emergency brake is also provided which applies shoes directly to the tires of the driving wheels. A lever actuating this brake extends up outside of the carriage, also convenient to the left hand. Incandescent electric lights are provided which give an illumination for night running, of course, far superior to any other form, and adds its share in making these vehicles truly representative of the period. All of the mechanical parts are entirely housed so that no moving parts are seen when the vehicle is running, other than the wheels. This gives a very simple effect in favorable contrast to the average motor carriage of the past. The finish of the carriage is one of its most striking features. In every particular it is essentially up to the standard of the most elegant equipages in use to-day.

Prof. S. H. Short's Personal Exhibit—The Denver Car.

FEW exhibits at Madison Square Garden can compare in interest and importance with that which has been kindly loaned by Prof. S. H. Short, namely, his quaint pioneer car used in Denver as long ago as 1885. This car has been placed near the exhibit of the Walker Co. (of which Prof. Short is the electrical engineer) on the main floor; while just across the hall is the regular type of New York Metropolitan car, operating upon a stretch of the latest type of Walker conduit. What a significant history of tremendous development lies between these two extremes!

The Denver car was built while Mr. Short was Professor of Physics in the University of Denver, and it is shown running on underground conductors. Prof. Short was a firm believer

even in those early days, in underground methods, and had a track three or four hundred feet long laid in the University grounds, over which this car, the "Joseph Henry," operated, a company called the Denver Electric & Cable Company being formed to do this, and also to build longer lines, until at last several miles were equipped and operated, with three regular cars in service. At that time, Prof. Short made a resolute effort to employ the series system in the transmission of the current, and the operation of the various lines; and he pursued his purpose with characteristic and laudable tenacity until he had thoroughly satisfied himself and the electrical public at large, that electrical roads must be operated on the multiple arc method. This exhaustive work of Prof. Short was a service to the art, the value of which cannot be overestimated,



THE "JOSEPH HENRY" DENVER CAR OF 1885.

and should be as fully counted to his credit as a bold pioneer as any of the earlier or later successes that he has made.

The car at the Exhibition is well preserved, and with its bright yellow paint catches the eye at once. Underneath it are shown the contact wires, over which the collecting bars or contact brushes ran—for Prof. Short was indefatigable in the means that he tried, and the same struggle was necessary as was required to work out practical forms of overhead trolleys. As a matter of fact, Prof. Short, then quite a young man, experimented with about all the devices that are feasible, and had slotted conduit tubes, shallow conduits, sectional conduits, circuit closers, conduits of the cable type, lights in the cars from the railroad circuits, electric gongs, single reduction motors, and a variety of other features, many of which are now so thoroughly embodied in the art that it would be difficult to reconstruct the art without them. It must be considered fortunate that the Exhibition includes so interesting a memento as this famous pioneer car.

The Exhibit of the Electric Storage Battery Co.

THE Electric Storage Battery Company's 50 foot sign at the eastern end of the building is one of the first features that attracts attention upon entering the Garden. Just below this sign there is mounted a row of large glass jars, each one carrying one letter of the words, "Chloride Accumulator," the well known trade-mark of the Company. Dummy lugs are used for connecting the jars together, and they present the appearance of a fully equipped battery. When illuminated from within, as it is each night, the sign presents a particularly attractive and novel appearance.

A novel use of battery plates is also shown in the sign which extends along the rear wall of the space. Twenty-seven plates of type G are exhibited, each plate showing, in unformed lead, one letter of the Company's name, the portion of the plate around the latter being peroxodized.

The operation of the chloride accumulator in a number of important applications is demonstrated. At the rear of the space, and mounted upon a handsomely finished stand, is a battery of sixty chloride accumulators of type F-11. This battery supplies power for operating the scores of motors, the sizes ranging from the smallest to the largest, in the adjoining space occupied by the Sprague Electric Co. As these motors are constantly being thrown on and off, the load on the battery is a varying one, having fluctuations of from 0 to 250 amp. The battery, connected across the line and charged from a constant source of supply, operates as a regulator of potential, the voltmeter needle remaining absolutely constant under the variations in load stated above. This application is a very interesting one as demonstrating the use of chloride accumulators in connection with electric elevators and on trolley lines.

Near the front of the exhibit are two large central station cells. One containing 27 plates 15½x32, is placarded as being the largest central station cell in operation at the time of the last Electrical Exhibition in New York, in May, 1896. The adjoining cell is from the largest storage battery in the world, and is one of the 166 cells which are being installed for the Chicago Edison Co. The front of the cell is cut away, permitting a very interesting view of the method of construction and plate suspension. The tank is 76⅜ inches long x 40½ inches high x 21½ inches wide, and contains 83 plates, each 15½x32 inches.

At the other end of the exhibit is a 25 foot electric launch of the most modern type built by the Electric Launch Co. at Morris Heights, N. Y., and equipped with chloride accumulators

EXHIBIT OF THE ELECTRIC STORAGE BATTERY CO., MAIN FLOOR.

A chloride accumulator for welding work is also shown. This outfit consists of one cell of type F-11 with a normal discharge of 50 amp. connected by heavy cables to copper clamps, by which the metal to be welded is gripped. In the welding

operations that are being shown, the cell discharges at rates ranging from 400 amps. to 1,000 amps.

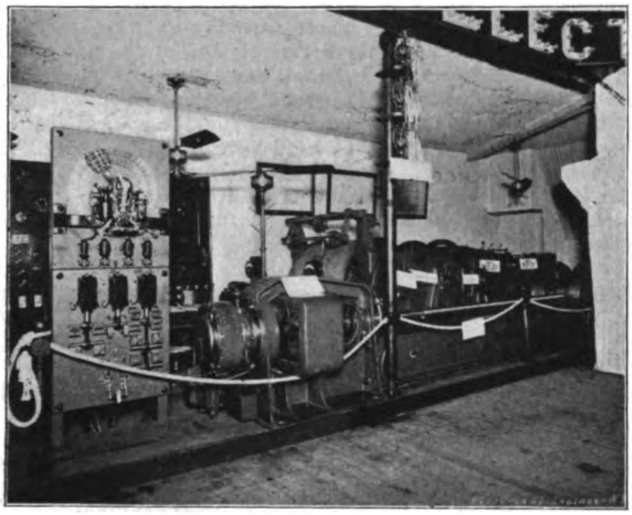
Chloride accumulators in portable form are shown operating phonographs, spark coils, fan motors, lamps, etc., and are also in use by a number of other exhibitors who have appliances calling for small powers.

The Battery Co. distributes a very neat folding foot rule, which is much appreciated by the recipients.

The exhibit is in charge of Mr. Chas. Blizard, manager of the Company's New York office, and Messrs. Albert Taylor, T. B. Entz, G. A. Robertson, W. H. Palmer and Carroll Hodge, all of whom are most courteous in their attentions to the countless visitors making all kinds of inquiries and asking all kinds of questions.

The Sprague Electric Co.

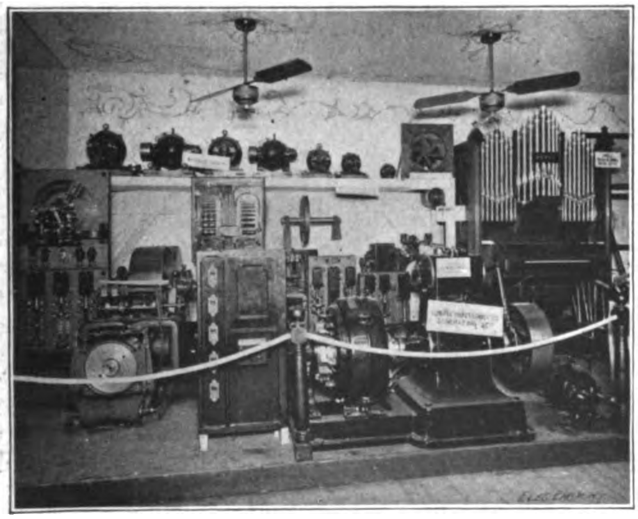
THE exhibit of the Sprague Electric Company at Madison Square Exposition is a remarkably fine one and quite characteristic of the Company. It is located at the east end of



SECTION OF THE SPRAGUE ELECTRIC CO.'S EXHIBIT. MAIN FLOOR.

the Garden, and occupies a space of considerable depth and 65 feet in width, illuminated by a very large and striking electrical sign. Although the space is large it is completely filled with exhibits of the various products of the Sprague Company.

Chief among these, perhaps, and in the foreground, is the



SECTION OF THE SPRAGUE ELECTRIC CO.'S EXHIBIT, MAIN FLOOR.

electric elevator exhibit. Therein are shown types of machines all the way from an ammunition hoist up to the now famous multiple-sheave and ball-nut machine in use in so many of the high office buildings in this country. Another notable elevator exhibit is a machine known as type "S," forty-nine of which are soon to be installed in London, England, for the underground railway of that metropolis. This type of machine is said to be the largest ever manufactured.

The Sprague exhibit seems to have been happily designed to excite popular interest, and the organ, almost continuously in operation, by means of a Lundell blowing outfit, and the dainty little house elevator machine always at the service of visitors, for operation, have caused the Sprague exhibit to be the constant centre of an interested throng. There are, of course, Lundell fan motors, power motors, dynamos, direct-connected generating sets, brass and iron armored conduit, and all the other specialties which have made possible the enormous business of the Sprague Company. Printers are a good deal interested in a two-revolution four-roller press, which is in operation, driven by a direct-connected slow speed Lundell motor.

All told, the Sprague exhibit is a striking feature of a striking show.

J. Jones & Son's Exhibit.

THE magnificent exhibit of Messrs. J. Jones & Son, of 64 Cortlandt street, which is located on the main floor at the right hand side of the Garden, by the first stairway leading to the Promenade, has at all times during the Exhibition been a centre of attraction by reason of the fine display, tasteful arrangement of the various instruments, extremely courteous treatment extended to all and the novel features frequently shown. At the entrance of the booth is a beautiful figure of the goddess of liberty, dressed by Mrs. E. A. Lowe, wife of the energetic and genial manager of this enterprising house. During the Exhibition all little girls visiting the Garden have been requested to write their name and address upon a card prepared for them and drop it in a slot at Miss Liberty's feet. At the

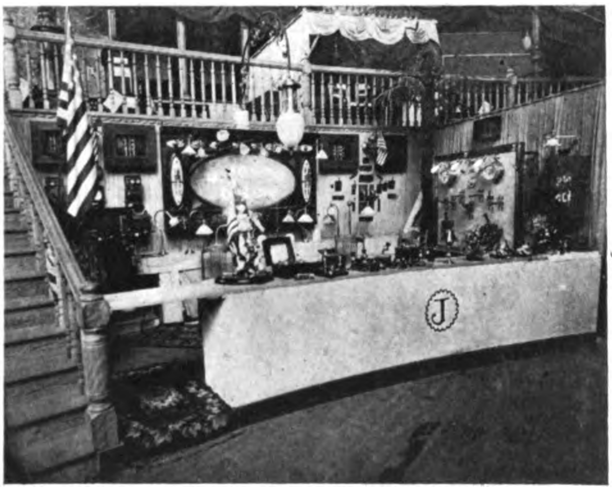


EXHIBIT OF J. JONES & SON, MAIN FLOOR.

close of the Exhibition this box of cards will be well shaken, and one card drawn out, the name of the little girl announced, and Miss Liberty will be sent to her address free, with the compliments of J. Jones & Son. At the back of the booth, which has been handsomely draped, is fixed a display board, the centre of which is a large oval panel, smaller panels running along the top and bottom and the two sides. The top panels are surrounded by various styles and sizes of incandescent lamps. Around the two side panels and the bottom panels are placed single and double pole switches.

In the large central panel, on a blue plush background, the name of "J. Jones & Son" is set in 8 c. p. frosted incandescent lamps. On both sides of this handsome display board are shown panel boards, switches, a new Ward-Leonard circuit breaker, wall telephone sets and an automatic cut-off clock. On the counter in the back of the booth are shown artistic porcelain shades, and at the front of the booth, on a long counter, are displayed numerous articles, such as electric curling irons, sad irons, soldering irons, an electric stove, desk and inter-communicating telephone sets, medical batteries (a specialty of this company), fan motors, etc. At the right of the booth is a handsome switchboard made by the firm. It is fully

equipped with Jones switches, Weston volt and ammeters, and a Cutter circuit breaker.

In the left hand corner of the booth is a large Holtz static electrical machine with a chime of silver bells upon it. This has afforded the visitors infinite amusement by the sweet tone of the bells and the sharp crack of the blue spark, fully eight inches long, which is shown and aptly explained by the attendant as "pure lightning."

Hanging directly over the centre of the booth is a beautiful arc lamps, which has not attracted any particular attention until a few evenings ago, when to the astonishment and amazement of all, the lamp was burning without its outer globe, and the ornamental brass jacket also removed, thus exposing the lamp in its nakedness, and showing decidedly one of the simplest and most effective arc lamps in the market, one for which Mr. Lowe is now perfecting arrangements to give it to the public. Another step of this enterprising manager is the company's recent removal to 64 Cortlandt street, where they occupy the entire building. On the first floor is the salesroom, on the second floor are the offices, the basement is used for shipping, and the upper floors for stock, besides adding space to their already large factory in Brooklyn. This very creditable exhibit is in charge of Mr. W. B. Burtis, who very ably and courteously explains the numerous interesting features.

The Hornsby-Akroyd Oil Engine—Exhibit of the De La Vergne Refrigerating Machine Co.

IN the basement amongst the steam, gas and oil engines, the exhibit that has attracted a great deal of attention is that of the De La Vergne Refrigerating Machine Co., who show effect. They have departed entirely from the beaten track of illuminated signs and the stringing of lamps, and have endeavored rather to represent the effect of interior illumination—a matter of some little difficulty, in view of the location and surroundings, and the fact that heavy machinery lends itself very little to interior decoration.

The whole of the decorative effect is in pure Empire style. A very handsome screen forms the background on which are painted two scenes illustrated with the use of "Hornsby-Akroyd" engines in connection with electric lighting. Each of these pictures is surrounded by the gilded frames of the conventional wreath and the typical Empire torches. The one represents a country home lighted up at night, while the other illustrates the use of the "Hornsby-Akroyd" oil engine in connection with searchlights. The effect is enhanced by illuminating these paintings from behind, and the searchlight is very effective. A man-of-war is painted on the back of the screen, and when the lights in front of the screen are turned off and those behind the scree turned up the searchlight is suddenly projected and the man-of-war springs into view. The illumination screen is very effective and worked in as part of the decoration. A light is placed in each of a series of Empire wreaths forming a frieze along the top, and in addition to these there are four very handsome wall brackets all in correct style. The stand is raised about 6 inches above the ground and is covered by a canopy of blue cloth richly studded with the imperial bee, as are likewise the two curtains enclosing the stand. The floor is in hardwood parqueted, and the furnitures, consisting of a desk and chairs, are authentic specimens of the finest Empire work. The introduction of costly furniture and fittings produces a very rich and pleasing effect.

HORNSBY-AKROYD OIL ENGINE EXHIBIT OF THE DE LA VERGNE REFRIGERATING MACHINE CO.

several examples of the "Hornsby-Akroyd" oil engine, of which they are the sole manufacturers in the United States.

It was to be expected that a firm of their reputation would make a creditable display, and it must be acknowledged that they have succeeded in producing a very unique and pleasing

All the lights on the stand are produced by a Hornsby-Akroyd oil engine running a C. & C. generator by link belt. The dynamo is placed behind the engine, so that the space occupied is not much greater than the floor space required for the engine. The De La Vergne Co. prefers the use of a belt with a single en-

gine (although the Hornsby-Akroyd oil engine has been built with two cylinders and directly coupled to dynamos with satisfactory results), for the reason that they are unwilling to sacrifice the great characteristic of the engine, viz. its simplicity, by introducing the application of several cylinders.

It is claimed, and apparently not without reason, that this engine can be run by a coachman or gardener, and as a matter of fact hundreds of these engines are in constant operation on plantations and farms where skilled labor is entirely out of the question.

A good deal of the prevalent skepticism as to the possibility of obtaining a steady light with an internal combustion engine will be dissipated by an examination of the light produced on this exhibit. The elaborate display of the De La Vergne Co. would have been of little account if the running of their engine had not been of the highest quality, and the total absence of flickering of the light is the subject of much favorable comment.

The engine itself is so well known as to need hardly any comment. It was put on the market about five years ago, and without any blowing of trumpet or beating of drum, it has steadily worked itself into public favor until it has attained an unassailable position. The Hornsby-Akroyd engine is in use in all parts of the world, and has been adopted by most of the European Governments in the face of the fiercest competition. The United States Government has not been behind, and is using it practically to the exclusion of all others for lighthouse service, torpedo service and searchlights.

It is interesting to note that the engine now running at Madison Square Garden is identical with over thirty recently ordered for the United States torpedo stations. Among other well known Government applications it may be mentioned that the Statue of Liberty is lighted by a Hornsby-Akroyd engine, and that the largest searchlight in the world at Navesink Heights will also be operated by this engine. In fact, over 100 of the Hornsby-Akroyd engines are, or shortly will be, in use by the United States Government.

It appears to be an engine admirably adapted for use in a country house, for lighting, pumping water, etc. The claim of absolute reliability seems to be justified by the fact that on every day since the opening of the Exhibition it has been started before 2 o'clock and shut down at 11 o'clock at night, and in no single instance has there been a stoppage for any reason whatsoever during those hours. Its simplicity is obvious from an inspection, there being a total absence of hot tubes, lamps, electric igniters, batteries, air compressors, etc.

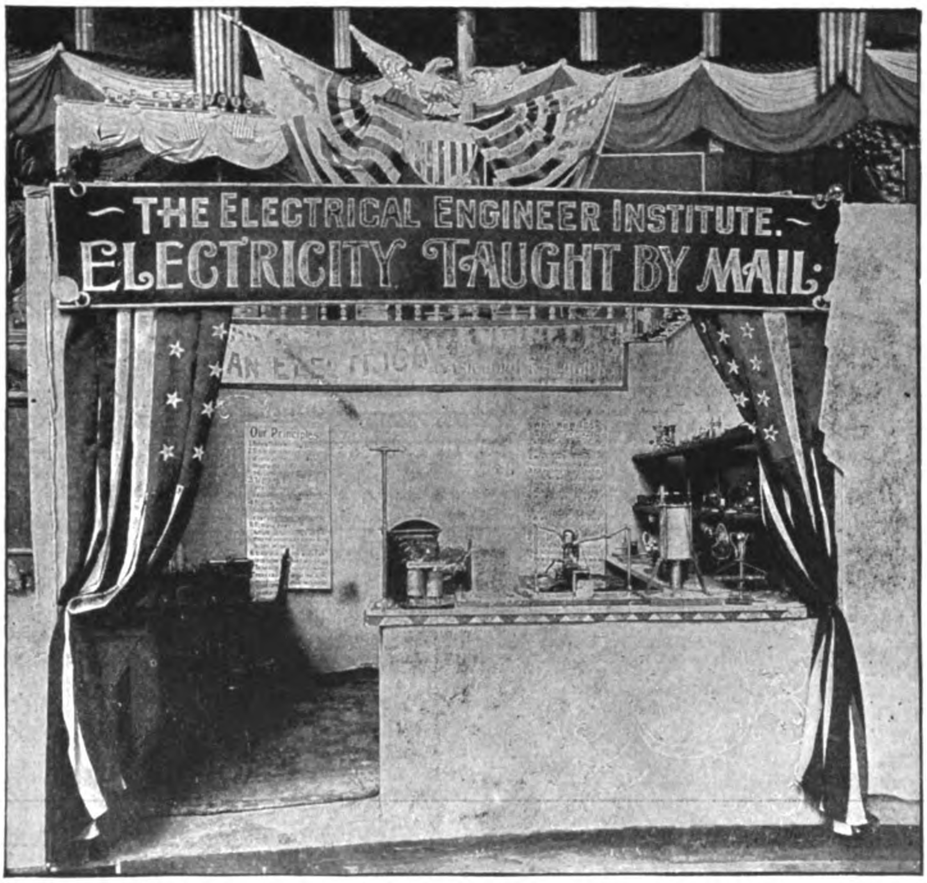
In the exhibit are displayed four engines, one of 32 h. p., one of 4 h. p. and two of 1½ h. p. each. The engines are very strong, of massive proportions and well adapted for the continuous hard work to which engines of this class are subjected. The rather large proportions for a given horse power are due to the fact that a very moderate pressure is produced by the combustion of the oil which conduces to the durability of the engine. Upon the whole it may be considered a thoroughly practical engine, designed for continuous hard work in the hands of unskilled labor rather than a scientific toy for the illustration of theories. The exhibit is in the efficient charge of Mr. E. H. Cox.

The Electrical Engineer Institute of Correspondence Instruction.

THE Electrical Engineer Institute of Correspondence Instruction has an exhibit on the main floor which is undoubtedly a great centre of attraction to both the layman and expert. This enterprising institution has, at great expense, fitted up a most complete laboratory at its booth, and nightly demonstrations are given with the various apparatus.

The experiments include almost all the important electrical manifestations, methods of generating electricity and many of the practical applications. The demonstrations begin about 8 p. m. and continue until the closing hour. The interest taken in these experimental demonstrations is clearly manifested by the large gatherings in front of the booth which almost block the aisle. There seems to be no thinning out of the crowd in front of this popular booth from the beginning to the end of the evening.

Mr. Joseph Sachs, of the Institute staff, is in charge of the laboratory, and in demonstrating the various experiments ac-



BOOTH OF THE ELECTRICAL ENGINEER INSTITUTE.

companies each with a clear and lucid description, worded so that even the non-technical mind can grasp the principles involved. To still further simplify and clear up the various electrical phenomena, a booklet entitled "Popularized Electrical Experiments" has been prepared, in which all the experiments are arranged in graded order, each being accompanied by an excellently clear, although concise, description. The audience of this popular lecture course is always eager to get these booklets, which are distributed free of charge and certainly furnish a most excellent syllabus of electricity and its applications. The elaborate and artistic Institute catalogues are also in great demand.

The experiments range from the elementary demonstration of the deflection of a needle to the more complex phenomena of the electric furnace and electro-chemical effects. Particularly prominent, however, are the production of calcium carbide, the electric water pail forge, electric welding, electric arc metal working, and the experimental demonstrations of the principles upon which the motor and dynamo are based. Many who are at first attracted by these fascinating experiments become intensely interested, and a large number of students have already been enrolled at the Exhibition. Judging from the multitude of inquiries and the favorable opinions of prominent electrical men at the Show, the Institute is an important factor in electrical engineering education.

As an educational effort the "Popularized Electrical Experiments" are undoubtedly worthy of the highest commendation. The Exhibition management, fully appreciative of this fact, has requested the Institute to present the lecture on a larger scale in the Concert Hall. This invitation has been accepted, and popular lectures on electricity with brilliant experiments are now delivered by Mr. Sachs three nights each week. These lectures are free to all and are to be regarded as a contribution to popular education by the Institute.

Mr. Herman A. Strauss, general manager of the Institute, and an able corps of assistants, including Mr. Willard M. Miner, Mr. Edward Hyans, and Mr. M. Cushner, are at the Exhibition every evening. They are almost continuously in consultation with eager inquirers, and enrolling students.

The fact that the guarantee of The Electrical Engineer accompanies all the Institute's work has proven to be an inducement to many, who fully appreciate the absolute good faith, trustworthiness and technical reliability of the instruction offered them.

Exhibit of the Fort Wayne Electric Corporation.

THE Fort Wayne Electric Corporation, of Fort Wayne, Ind., are ever at the front in presenting novel features of display. To the right of their space, which by the way, is a most prominent one, being directly to the west of the centre, and surrounded by four aisles, is a 37½ k. w. low frequency (60 periods) alternator, generating current at 1,000 volts, whose current, after passing through transformers, reducing the voltage to 100, is utilized in showing the operation of the Corporation's new enclosed alternating current arc lamps, and their latest types of lamp hour, ampere hour and kilowatt hour, alternating recording meters. The operation of these meters, on different loads, is gracefully shown by the addition of an ammeter and several banks of lamps connected to lamp switches. The visitor is shown two kilowatt hour meters connected in series and operated on a single lamp. The straight line law common to these meters is clearly shown by observing the number of revolutions on a given bank of lamps, the revolutions per lamp minute of the meter being known. The alternating current generated is further utilized by one of the Fort Wayne Electric Corporation's self-starting single phase synchronous motor of 5 h. p. capacity. Although these machines have been but two years on the market they have made a vast number of acquaintances and friends. Their load starting feature insures a great popularity. The alternator is directly connected to a four-pole motor, which operates it at a speed of 900 revolutions per minute.

To the left of the space one of the well known "Wood" arc dynamos is represented in the shape of an 80-light 2,000 c. p. unit. The improved regulator with which this machine is equipped is conspicuous for its compactness and simplicity, being entirely on

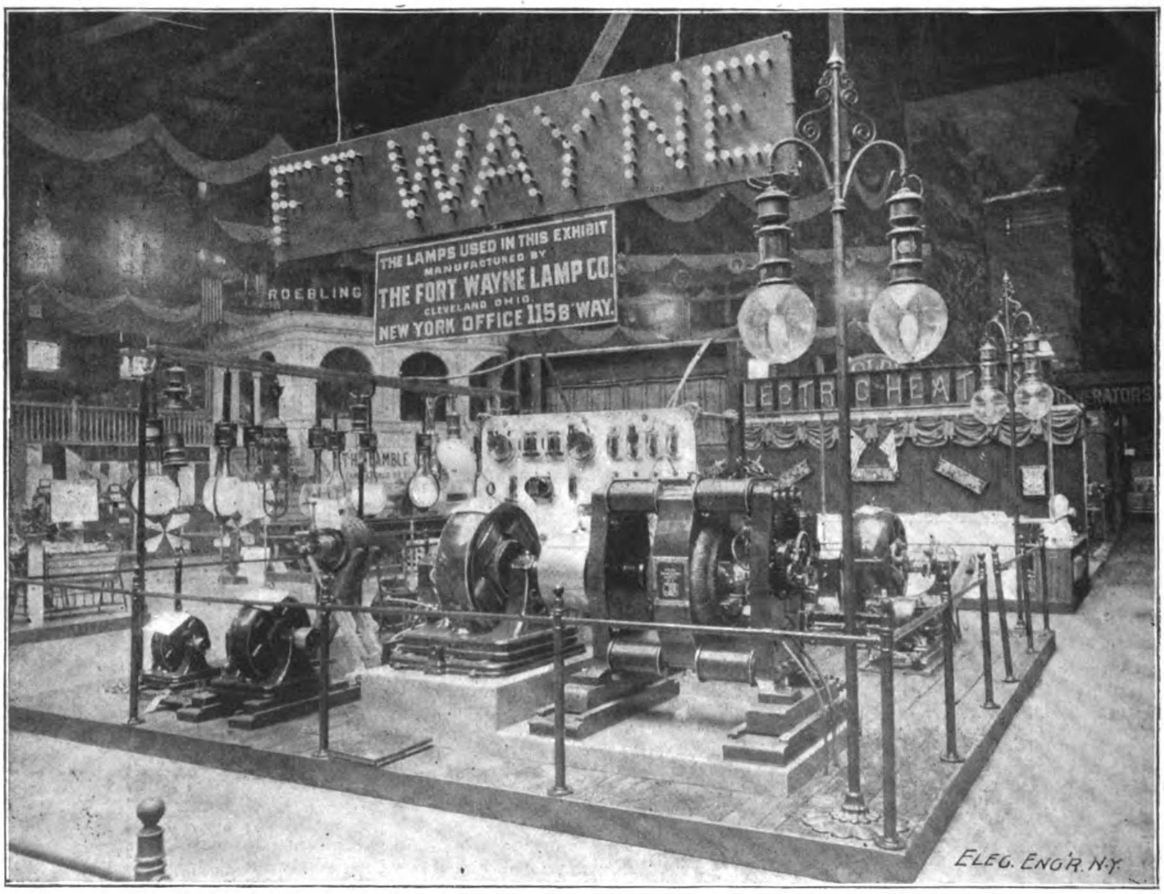


EXHIBIT OF THE FT. WAYNE ELECTRIC CORPORATION AND THE FT. WAYNE LAMP CO.

the machine, so that all wall controlling devices and outside regulator connections are done away with. The arc dynamo is connected to a rack of arc lamps which, although they do not load the machine, are sufficient to show its operation. The machine is driven by a belted direct current multipolar motor.

The rest of the exhibit includes lighting transformers, arc light transformers, small motors and a handsome marble combination switchboard containing necessary apparatus for the handling of the alternating and arc circuits. Mention should also be made of a new commutator burning device shown in operation. It consists of a simple tool operated by hand for facing the commutator perfectly true with the bearings, a most valuable adjunct to an electrical plant. The Fort Wayne Electric Corporation is ably represented here by Mr. F. A. Wunder, assisted by Mr. J. C. Lott and Mr. Thos. A. Nathans, from the New York office, at 115 Broadway.

The Fort Wayne Lamp Co., of Cleveland, O., who are connected with the above, and who exhibit, in conjunction with it, have a unique display of their famous tipless incandescent lamps. The frosted lamps in the massive "Fort Wayne" sign, on the meter board, and in several large baskets distributed about the booth, give the visitor an opportunity of minute examination, as well as an appreciation of their general artistic effect. Mr. T. E. D. Ritchie, Eastern sales agent, is in charge, and explains very effectually the merits of the lamps.

The Apparatus for the Telegraph Tournament.

J. H. Bunnell & Co., with wonted enterprise and generosity fitted up the platform in the Concert Hall at the Electrical Exhibition with apparatus for the telepraph tournament, and Mr. Bunnell was himself most active in his efforts to have things go smoothly and well. As an old-timer he has lost none of his interest in achievements at the key, and he keeps in close touch with all the new men coming to the front or "going to the front."

The R. Thomas & Sons Company's Exhibit.

A VERY striking and instructive exhibit on the main floor is that of the R. Thomas Sons Company, of East Liverpool. Ohio. The booth is beautifully draped in blue and white, and on a star surrounded by small porcelain knobs appears the name of the company in gold letters. They are exhibiting their well-known porcelain specialties, among which should be mentioned the triple petticoat insulator which is said to be puncture proof and the strongest insulator mechanically as well as the best electrically. The attendant at the booth shows the latter quality

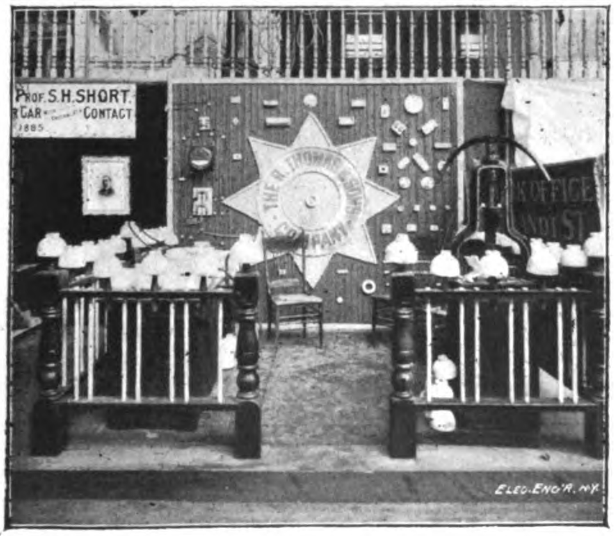


EXHIBIT OF R. THOMAS & SONS.

very strikingly by submitting insulators submerged partly in salt water and thoroughly drenched with it, to a potential of 60,000 volts, which is produced by a Westinghouse testing transformer. The current which at first leaks over the surface will jump a number of inches from one terminal to the other after the surface has become dry. These tests are made on glazed as well as unglazed insulators and all of them stand the test admirably. Besides these insulators, the company exhibit the "Boch Glaze Filled" high potential insulators, described in The Engineer, April 7. A miniature triple petticoat insulator is given away by the company as a souvenir.

The Exhibit of the Peckham Truck Co.

THE Peckham Truck Company are exhibiting their numerous and well known products in various portions of the Exhibition. In their own space on the main floor are found neat and carefully constructed models of the 14-B short wheel base swivel trucks and one of their 14-D swing bolster maximum traction trucks. They are also exhibiting one of their Metropolitan special high speed single trucks under the car

EXHIBIT OF THE PECKHAM TRUCK CO.

body in the Stephenson Car Co.'s exhibit. There is also found in the Walker Co.'s exhibit one of the company's 7-B-X Excelsior trucks, showing a different arrangement of the cantilever side frame design, which is the distinguishing feature of the Peckham single trucks. These two applications of the Peckham trucks are the operative portion of their exhibit, and are in constant use during the evening. A detailed description of the company's exhibit appeared in our issue of May 12.

Paragon Fan and Motor Exhibit.

ANYONE whose good fortune has permitted him, or rather whose good sense has taught him to supply himself with a fan motor during the summer months, can understand why

EXHIBIT OF PARAGON FANS AND POWER MOTORS.

the space wherein 106 fan motors are all in continuous operation is constantly surrounded by an appreciative throng. Such an exhibit is that of Mr. J. P. Williams, the well-known manufac-

turer of the "Paragon" fan and power motors. In pyramidal form he has mounted 106 14-inch and 16-inch fan motors of various colors and design, of the bracket as well as desk types, and the whole is capped by a huge Paragon motor in the form of a big white windmill rotated by a $\frac{1}{4}$ h. p. motor, and having affixed to its large white wooden blades 150 incandescent lamps. The effect of this display is refreshing, and were it not for the cooling of the air around this booth, one would hardly know that the motors were in operation, so noiselessly do they run.

There are shown besides these motors, $\frac{1}{4}$, $\frac{1}{2}$ and 1 h. p. power motors, a 1 h. p. generator, and a $\frac{1}{2}$ h. p. motor with prolonged shaft, having mounted on one end an emery wheel and on the other a buffing wheel. Numerous ceiling and column fans are shown and in one corner of the booth is shown one of the special features of the show, namely, a cradle rocked by means of an electric motor. Within this cradle is a large doll, and above it is a sign bearing the inscription, "The hand which rocks the cradle rules the world." And no one will deny, after seeing this splendid "Paragon" exhibit, that the domain over which the electric motor holds sway is extensive and important. The exhibit is in charge of Mr. J. P. Williams, assisted by Messrs. J. H. Campbell and A. W. Turner.

Notes on Various Interesting Exhibits.

THE BABCOCK & WILCOX CO., who have furnished the two 265 h. p. boilers of their complete forged steel construction, built for 200 pounds' pressure, referred to in detail in our issues of May 5 and 12, have lately added a very interesting

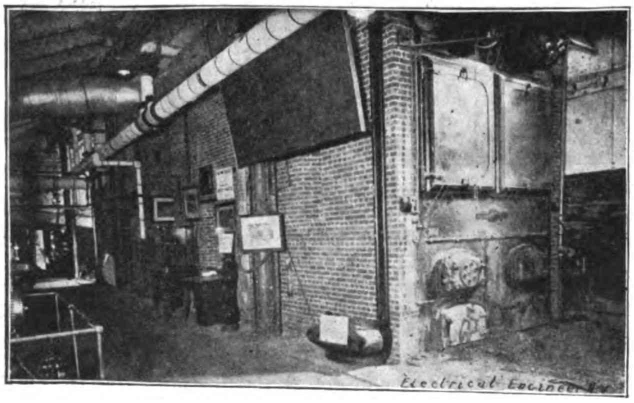


EXHIBIT OF BABCOCK & WILCOX BOILERS, BASEMENT.

feature to their thoroughly practical and useful exhibit. It is a complete model of a longitudinal section of a B. & W. boiler, showing the construction of every portion of the boiler as well as the setting. It is placed under a glass case and is always surrounded by interested visitors to the Exhibition.

THE BOSSERT ELECTRIC CONSTRUCTION CO. have

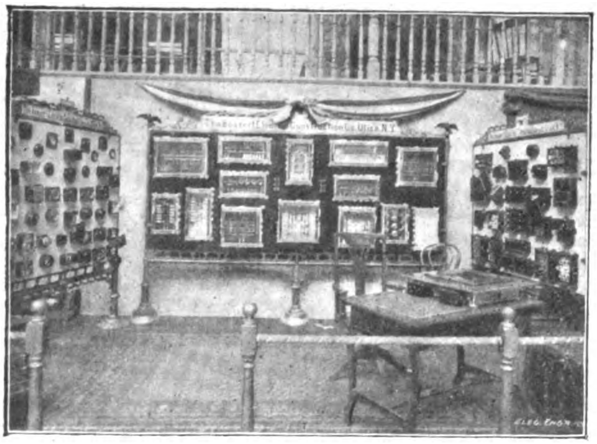


EXHIBIT OF THE BOSSERT ELECTRIC CONSTRUCTION CO.

arranged a very tasteful exhibit on the main floor, showing a complete line of steel drawn outlet and switch boxes, representing the latest improvement in wall boxes, as they are constructed entirely of one piece of wrought steel, being absolutely indestructible and thoroughly fireproof. They also exhibit various types of steel-clad, self-contained main junction and distribution boxes. This type of box is designed especially to meet the objection of the underwriters and electrical engineers generally to a combustible box enclosing a panel board. They are thoroughly fireproof and are designed for any number or arrangement of circuits with or without switches.

THE K. & W. COMPANY, of Pittsfield, Mass., manufacturers of Hardy incandescent lamps, composite dynamo brushes, hanger boards, spark arresters and anti-spark lubricating compound, are making a very creditable exhibit of these products,

EXHIBIT OF THE K. & W. CO.

in charge of Mr. C. Houliston. A detailed description of the exhibit was given in our issue of May 5, but special mention may again be made of the excellent incandescent lamp product of this company, which attracts no small amount of attention.

THE AMERICAN ENGINE CO., of Bound Brook, N. J., have arranged a very tasteful exhibit in the generating section

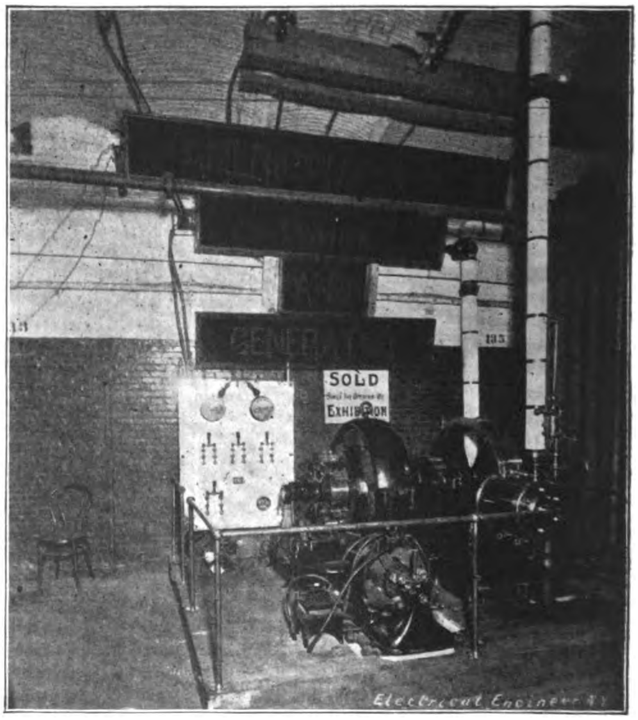


EXHIBIT OF AMERICAN BALL ENGINE AND DYNAMO, BASEMENT.

opposite the battery of boilers and adjoining the Engineering Picture Gallery. They are showing an American-Ball engine direct connected to a 25 kilowatt generator, and unless a person

were to get very close to the unit, so that he can actually see it moving, he would never know that it was in operation, so well balanced are the engine and dynamo. It operates absolutely noiselessly and is a model of mechanical and electrical design. Besides this unit there are shown a 5 h. p. multipolar motor and a neat switchboard equipped with switches, measuring instruments and rheostat. An attractive sign composed of red miniature incandescent lamps announces the exhibit which might almost pass unnoticed, due to the noiselessness of the operating machinery. The exhibit is in charge of Mr. Jos. Englesby.

The Nowotny Electric Co.'s Exhibit.

The Nowotny Electric Company, Cincinnati, Ohio, are exhibiting in a handsomely decorated booth their new style enclosed arc lamp, which is claimed to be superior to other lamps in that the general arrangement of the lamp is such that it is extremely easy for even an inexperienced person to recarbon and take care of it. The resistance being inside the outer globe, prevents any possible danger of burning out the magnet coil or scorching the ceiling. There are no adjustments to get out of order. Owing to the simple manner in which the inner globe is held in position there is ample room for it to expand without danger of breaking it. The outer globe is held in position in such a manner that it can be raised or lowered without detaching it. Another feature of the exhibit which is quite new and is attracting considerable attention is an arc lamp connected singly across a 220 volt circuit taking 2½ amp., with 160 volts across the arc. Mr. Chas. A. Aull, the electrical engineer of the company, and the designer of the lamps, represents the company at the Exhibition.

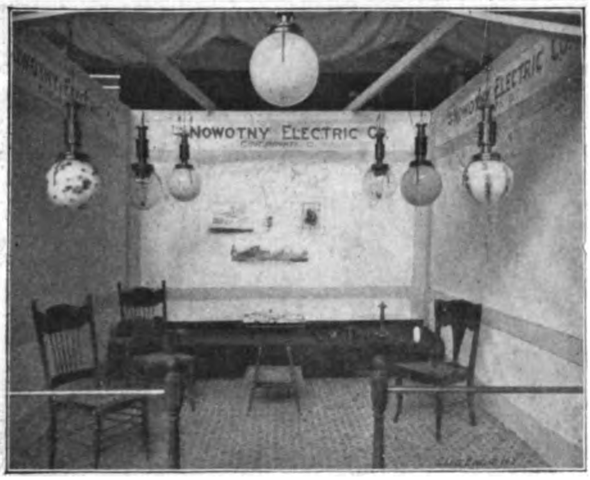


EXHIBIT OF THE NOWOTNY ELECTRIC CO.

The Diesel Motor Co.'s Exhibit.

UNDOUBTEDLY no exhibit in the operating department at Madison Square Garden attracts more attention than that of the Diesel Motor Co., and for good reasons. The remarkable performances of the Diesel motor had served to whet the curiosity of power users, and many are the inquiries which the company's representatives are obliged to answer.

The Diesel motor on exhibition is of 20 horse power, coupled directly by a rigid coupling to the armature shaft of a C & C generator. The motor was not built for electrical work, but it is an ordinary 20 horse power stationary motor intended to run machinery by belt drive. It runs at only 170 revolutions per minute, is a large cylinder motor, and like all internal combustion motors, works on the four stroke cycle. Time was not available to change the gearing for higher speed, desirable as that appeared for electrical work. It seemed therefore a bold undertaking to attempt to make it drive an electric light generator. But public interest in the Diesel motor has been so aroused and the opportunity to exhibit it at the Electrical Exhibition seemed so favorable, and above all, the directors of the company have such absolute faith in the motor, that they determined to exhibit it even under these adverse conditions.

Delays in shipment and in the custom house, reduced the time for preparation. The only change that could be made in the time available, was to supply the engine with a somewhat heavier fly-wheel than necessary for its ordinary work, and after two days of preparatory run, it was set up in the Exposition and carries its load of lights with less than 1½ per cent. variation in speed. It requires less than a minute to start the engine

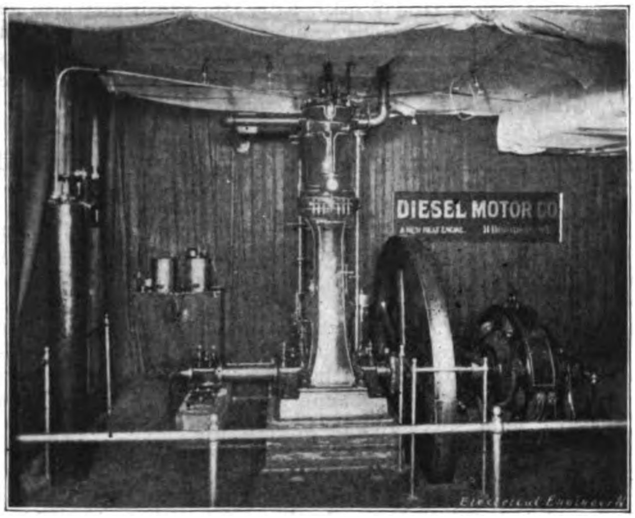


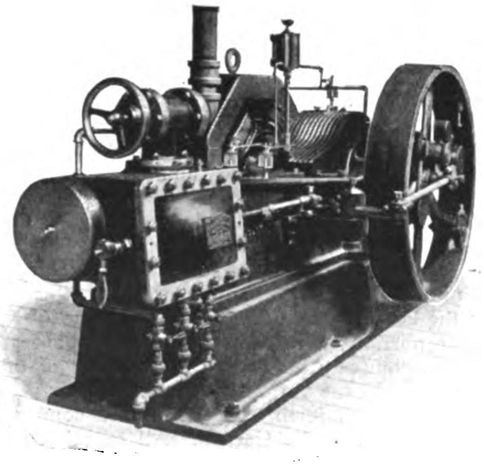
EXHIBIT OF DIESEL MOTOR CO., BASEMENT.

when perfectly cold, and within two minutes it is running at full speed with its load. We believe that this is the first instance on record that a single cylinder internal combustion engine has ever accomplished these results. Those who have studied the working of the Diesel motor find the reason for this success in its controlled and perfect combustion and the absence of any explosive action. A full description with illustrations of the internal construction of this interesting machine will be found in The Engineer of Feb. 17, 1897.

Burhorn and Granger.

Messrs. Burhorn & Granger, 136 Liberty street, New York, and Stephen Girard Building, Philadelphia, Pa., are exhibiting in operation a 9 inch by 12 inch "Woodbury" high speed engine, direct connecetd to a 25 kilowatt "Eddy" generator. This engine is of the latest improved type, equipped with "Shepherd" governor with which they guarantee a regulation of one-half of one per cent. for all variations of load, and also their automatic oiling system, to which they invite attention. The regulation can be tested by visitors with the aid of a recording Schaffer & Budenberg tachometer at the exhibit.

Another portion of their space is taken up with a sectional model of the "Woodbury" cylinder and steam chest, showing



"WOODBURY" ENGINE DIRECT CONNECTED TO EDDY GENERATOR.

the "Woodbury" valve, the method of adjustment and means of providing for entrained water. This portion of the exhibit proves very interesting to visitors, who are thus enabled to see the inside of the same size engine as that which is running.

Attention is called to Messrs. Burhorn & Granger's exhibit by a revolving illuminated sign, aided by an attractive souvenir card which they distribute and on which announcement is made of the various houses which they represent, including the Stearns Mfg. Co., of Erie, Pa.; Harrisburg Mfg. and Boiler Co., of Harrisburg, Pa.; Philadelphia Engineering Works, Philadelphia, Pa., and Union Iron Works, Erie, Pa., and it may also be noted that since the previous exhibition they have opened a Philadelphia office under the management of Messrs. Charles E. Machold, M.E., and A. H. Riddell. The exhibit is in charge of Mr. Granger.

The Joint Exhibit of Stanley & Patterson and the Ziegler Electric Company.

ON account of the great variety of products displayed, their tasteful arrangement and excellency, the large booth jointly occupied, on the Arena Circle, by Messrs. Stanley & Patterson, of New York, and the Ziegler Electric Co., of Boston, has always been a centre of attraction at the Show. At the back of the booth against pale green drapery are arranged the various products of Stanley & Patterson, such as telephone supplies, consisting of long distance and exchange telephones, toll line cabinet sets, electric light specialties, switches, etc., electric bells, annunciators, wire, fans, desk lights, shades and Shelby incandescent lamps. These lamps are tastefully arranged so as to form the letters S. & P. and present all colors of the rainbow. Fifty-five of these lamps are used, which are particularly striking on account of their splendid natural coloring, and the globes without tips. Two incandescent arc lamps are suspended from the ceiling.

The Ziegler Electric Co. are exhibiting on the counter at the front of the booth and in glass cases, their numerous products, embodying many decided novelties and improvements. There

STANLEY & PATTERSON'S AND ZIEGLER ELECTRIC CO.'S EXHIBIT.

are shown measuring instruments and testing sets of an infinite variety, such as voltmeters and ammeters, galvanometers, bridges, keys, etc., medical apparatus, Geissler tubes, and a complete X-ray outfit, consisting of induction coils, tubes, condenser, etc., as well as of batteries, fan motors, lamps, fixtures and switches. The chief feature of the exhibit, however, is the searchlight and stage lamp manufactured by this company. Fourteen of the latter are used for the illumination of the tower, and in another portion of this issue their admirable features are explained. The company have placed a number of their well-known searchlights in the various booths, and their penetrating, steady rays have called forth many favorable comments from the numerous visitors at the Garden. All questions regarding the Ziegler products are cheerfully answered by Mr. Chester Snow, the treasurer of the company, and Mr. A. F. Stanley is on hand to look after the interests of Messrs. Stanley & Patterson.

COMR. F. E. BARKER, of the Massachussetts Gas and Electric Light Board, was in New York last week, and a visitor to the Electrical Exhibition.

The Faries Mfg. Company's Exhibit.

THE Faries Mfg. Co., of Decatur, Ill., manufacturers of the Faries universal adjustable electric lamp holders, aluminum and steel electric lamp shades, and fire and water tube boiler cleaners, have recently established an Eastern office at 136 Liberty street, New York city, under the management of Mr. A. W. Koenig, who has arranged a very neat, attractive and interesting exhibit at the Electrical Exhibition, which is illustrated below. The exhibit is located on the promenade just above the main floor, adjoining the New York Telephone Company's Theatrophone exhibit, and we would advise all our readers who visit the show to call and see it, as we are positive the universal adjustable electric lamp holders exhibited by this firm will interest everybody, electrical contractors, engineers, electricians, electrical supply dealers, as well as the general public, who may be fortunate enough to use electricity in their offices or private residences. The placing of the Faries universal adjustable electric lamp holders before the public meets the long felt want of being able to get your light just where it will be of service to you, both in reading and working. Some of them are adjustable in four or five places, so that it is very easy to arrange them to throw your light anywhere that you may wish it, by merely adjusting the fixture at any angle necessary. These fixtures are manufactured of the finest material, and the best of workmen are employed only by the firm, so that no efforts are spared to turn out the best fixtures on the market, at the most reasonable prices. They are made in about thirty different designs of portable and stationary desk

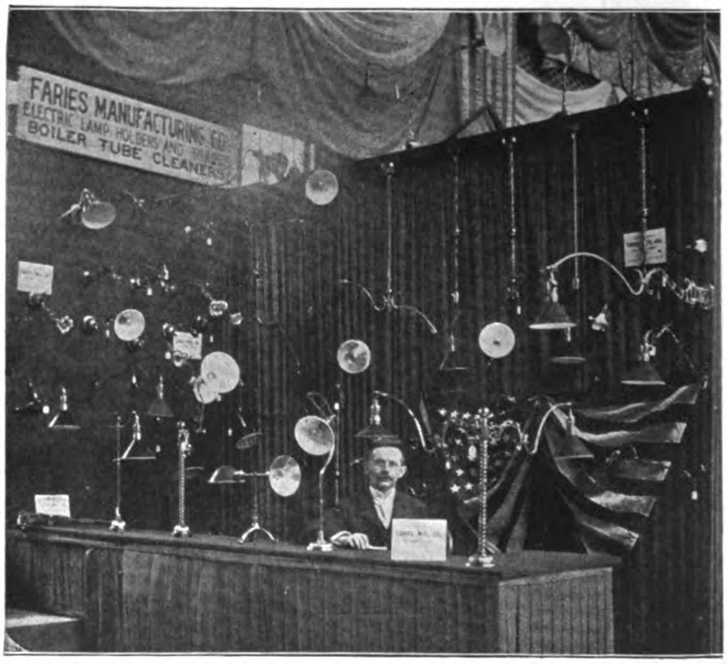


EXHIBIT OF THE FARIES LAMP HOLDERS AND FIXTURES.

and table lamps, side wall fixtures, chandeliers, pendant hall lamps, and dental lamps. They are all very unique and attractive in design, while not at all elaborate, thus making the cost very reasonable. The aluminum and steel electric lamp shades or reflectors are made in three styles—the parabola or half shade, the cone shaped, and the ceiling shade. They are not only shades, but reflectors of the very highest order. The holder reaches well over the shank of the lamp, leaving the shade to begin at the top of the filament, thus enabling a smaller shade of same angle to cover the lamp, as well as a larger one with old style of holder. Being smaller, it is lighter and less in the way; being lighter it is easier to handle and to be borne by light fixtures at different angles, and is not apt to rack or pull the socket to pieces as heavier shades are. They fit any socket and are easier put on or off, and have a neater appearance than the old style of shade and holder. They are seamless, and are made both of steel and aluminum; both are enameled either black or green outside, and the steel ones are finely enameled white inside, while the aluminum ones are highly polished inside. The parabola has the further advantage of throwing the light from the side of the lamp, which gives evener illumination, and

as the holder swivels on the socket, the shade can be turned to throw the light to any angle.

The advantage of the fire and water tube boiler cleaner manufactured by this firm is that it expands when shoved forward in the tubes and collapses when pulled backward, so that it will never get stuck. It is easily adjusted for variations in sizes of tubes, and has a ram which enhances the ease and facility of operation, especially when tight and uneven places in the tubes are encountered. There is no leather or rubber about the cleaner, and it does the entire work without the use of steam or water. Mr. A. W. Koenig, who is in constant attendance, will be pleased to answer all questions relating to the above products or send catalogues to any one on application. He would also request the company's patrons in the Eastern States to send inquiries and orders to the New York office, in order to save time and expense in shipping.

The Barrows Vehicle Company of New York.

THIS company are represented by the president, Fred. W. Duncan, and have on exhibition two types of their tricycle electric vehicles; these vehicles differ from all the others in that they have only three wheels and the load and steering is done by means of the single wheel which runs in front, being modeled closely after bicycle methods. They have another peculiarity in that the body is interchangeable so that different styles of bodies may be mounted upon the same running gear, one being independent of the other. The frame is of steel tubing and bent

EXHIBIT OF BARROWS ELECTRIC VEHICLES.

in the form of a goose-neck, the end of which rests upon the top of the single wheel.

As noted above, a framework or saddle is provided in which the batteries are carried on each side of the driving wheel, and these, mounted a little below the centre, give the vehicle great stability. The motor is mounted against the carrying frame in rear of the batteries and is geared for one or two horse power, depending upon the size of the vehicle. The power is communicated by means of a pinion working on an internal gear attached to the spokes of the driving wheel. The gear is of large diameter, giving to the motor great leverage and permitting of a very simple construction in that the power is applied so near to the rim of the wheel, that heavy axle strains are avoided. The driving wheel is 38 inches in diameter and the rear wheel 28 inches; all of the bicycle pneumatic tire type.

The leads from the batteries are brought up to a circular controlling apparatus in front of the driver and by a movement of the handle three speeds are obtained, four, eight and twelve miles per hour forward and a backward speed of four miles. The front wheel is so evenly balanced that the steering is very easily done. A bicycle type of lamp is employed and the light is produced by means of acetylene gas.

The brake is applied by means of a foot lever and works on the rim of the tires of the rear wheels. All the wheels are provided with ball bearings, and all the equipment is light and graceful having sufficient strength, however, for all purposes. The weight of the smaller vehicle is 1,200 pounds; 640 pounds is assigned to the batteries. The batteries are a special type manufactured by Sipe & Sigler, Cleveland, Ohio. The small vehicle exhibited has a capacity for a run of 20 miles and the large one for 40 miles where the roads are reasonably good; the company do not recommend the electric type of horseless vehicles where there are steep hills, or where mud and sand or snow predominate. The batteries are charged with 110 volts direct current, and, where they are charged from city mains, the average cost, it is claimed, is about one and a half cents per mile, but with the special plant which the company design and

EXHIBIT OF THE BERLIN IRON BRIDGE CO., MAIN FLOOR.
(For description see issue of May 12.)

furnish and which they recommend, consisting of a dynamo and gas or gasoline burning engine, the charging is estimated at less than one-third of a cent per mile. The batteries are guaranteed for five years service, and the cost of maintaining is claimed to be not over $75 per year, while that of the motor is estimated at $10. Counting the care of horses and the comparative amount of room occupied by horseless vehicles with that of the ordinary vehicles together with the animals, the expense is very much less than that of maintaining the ordinary vehicles, for, unlike the horses the batteries eat only when they work.

LETTERS TO THE EDITOR

Early Trolley Roads.

Let me assist Mr. Henry in the matter of early trolley roads. In 1886 a double trolley road was in operation, connecting the village of Montreux, Chillon, and Villeneuve, at the head of Lake Geneva, in Switzerland.

The two conductors were hollow brass or copper tubes, open at the bottom. In these tubes were metallic plungers 8 to 10 inches long, with wire brushes at each end of them, to make good contact with the tubes.

The wires were fastened to the centre of these plungers. They were flexible cords twisted into a rope, and as the car ran, it dragged the plunger after it.

The power came from a dynamo, up the mountain side, moved by a water wheel; and the boy up there, who acted as chief engineer of his power station, was telephoned from time to time, for more or less current.

Altogether this little road was a curious affair. Where it wound through the narrow, crooked streets—too narrow for sidewalks and poles—the trolley tubes were supported by handsome iron brackets, projecting from the building fronts.

I presume the road is still in existence. When I saw it, in 1886, it was in good order, and bade fair to run for years. I do not know how long it had been built.

Buffalo, N. Y. H. HASKINS.

SOCIETY & CLUB NOTES

Mr. A. E. Kennelly, Prest. A. I. E. E.


Mr. A. E. Kennelly.

The American Institute of Electrical Engineers in electing its new Council has done well in the choice of Mr. A. E. Kennelly for the presidency. That gentleman illustrates in his career the wide range of Anglo-American interests, for, born of English parents in Bombay in 1861, he has been resident in this country for ten years past, and has done much to raise the standard of American electrical engineering. Mr. Kennelly was for many years active in submarine cable work, and in 1887, received the premium of the Institution of Electrical Engineers of England for a paper on localizing cable faults, as well as the Institution Fahie premium in 1888. During the latter year, he resigned from the service of the Eastern Telegraph Company and became electrician to the Edison laboratory. In 1894 he joined Prof. Houston in establishing the professional firm that bears their name, and in the publication of a large amount of valuable literature, such as the "Electrical Engineering Leaflets," published by this journal. Mr. Kennelly is a fellow of the Royal Astronomical Society, a member of the Franklin Institute, the English Institution of Electrical Engineers, etc., etc. In 1895 he received the honorary degree of Doctor of Science from the University of Pennsylvania for original work in electrical research.

American Institute of Electrical Engineers.

The annual meeting of the Institute for the election of officers and the transaction of other general business was held in New York city on May 17. The report of the Council was submitted, giving, among other things, the membership of the Institute as 1,098, made up of 2 honorary, 352 regular and 744 associate members. The income for the year amounted to $10,027. Committees were appointed to count the ballots and examine proxies. While these committees were at work attention was called to the large number of associate members in comparison with the number of regular members, and it was suggested that the Examining Committee recommend to such members as it considered eligible that they apply for transfer to full membership. The fact that only 150 of the new badges had been sold during the year, and that only 23 old ones were exchanged was commented on. The election of the following officers was announced: President, Arthur E. Kennelly; Vice-Presidents, Prof. Robert B. Owens, William Stanley, Jr., Dr. Cary T. Hutchinson; Secretary, R. W. Pope; Treasurer, George A. Hamilton; Managers, Herbert Lloyd, Dr. Samuel Sheldon, Prof. George F. Sever and Charles P. Steinmetz.

At the meeting of the Executive Committee in the afternoon the following associate members were elected: Felix Louis Cadou, Superintendent and Electrician, Washington Street Railway Co., Washington, Ind.; Thomas Dempster Electrical Engineer, General Electric Co., Schenectady, N. Y.; Paul Letheule, Electrical Engineer, commissioned by French Government, 24 Front street, Schenectady, N. Y.; Livingston Johnston, Jr., Islip, N. Y.; Howard Joslyn, Assistant Engineer, Snoqualmie Falls Power Co., Seattle, Wash.; James J. Mahony, Engineering Assistant to Manager Railway Department, General Electric Co., 115 West 47th street, New York city; Irving A. Taylor, Motor Inspector, Edison Electric Illuminating Co., 360 Pearl street, Brooklyn, N. Y.; Wallace Rupert Turnbull, Foreman of Experimental Room, General Electric Lamp Works; residence, 29 South Arlington avenue, East Orange, N. J.; James H. Winfield, Superintendent Eastern Division, Nova Scotia Telephone, Limited, New Glasgow, N. S.; Fred. W. Wood, General Manager, Los Angeles Railway Co., 1722 South Flower street, Los Angeles, Cal. Total, eleven.

The following associate members were transferred to membership: Edward Burch, Electrical Engineer, Twin City Rapid Transit Co., Minneapolis, Minn.; G. A. Redman, General Superintendent Electrical Department Brush Electric Light Co., and Rochester Gas and Electric Co., Rochester, N. Y.; L. S. Boggs, Pioneer Electric Co., Ogden, Utah; Gustave J. Fischer, Engineer for Tramway Construction Public Works Department, Sydney, N. S. W.; James B. Scott, Electrician and Mechanical Engineer, 227 East German street, Baltimore, Md.

Lecture By Prof. I. Fujioka Before the New York Electrical Society.

FOLLOWING up its success with the lecture by Dr. S. S. Wheeler, the New York Electrical Society made another hit with the lecture on Thursday evening last by Prof. I. Fujioka, on "Electrical Developments in Tokio and the Empire of Japan Generally." The Concert Hall was crowded, and the large audience not only heard an excellent lecture, but was delighted and surprised with a long series of admirable lantern slides of Japan, of Japanese warships and of the war in Corea and China. The latter slides, of purely Japanese origin, were very clever and spirited, and were welcomed with the keenest interest, as were Prof. Fujioka's brief explanations of them. In spite of the fact that he spoke in English, the Professor's remarks were closely followed, owing to his ready command of the language.

Prof. Fujioka's lecture dealt chiefly with the telegraph, telephone, electric light and power, and electric railway work; and it gave statistics in regard to each of these departments. In 1896 Japan had 12,000 miles of land telegraph pole line and 1,122 telegraph offices. The number of messages sent and received in the interior was 22,250,000. At the end of 1896, there were 6 local telephone exchange systems, with 540 miles of pole line and 3,232 subscribers. There are now some 40 central station lighting companies in Japan, and in Tokio alone the number of lights supplied is 50,000, of which 40,000 are furnished by the Tokio Electric Light Co., which has five stations of various types, including three-phase and Edison three-wire. A number of companies have been formed to carry out power transmission enterprises. Two at Tokio are going to develop about 30,000 h. p. from water, transmitting the current forty or fifty miles at 10,000 to 20,000 volts.

Two cities in Japan, Kyoto and Nagoya, have electric street railroads. Two companies have been organized which will equip Tokio with an ultimate 200 miles of trolley road. A large number of other lines are being projected or laid out, making a total of two or three hundred miles, and in much of the work Prof. Fujioka is interested. American apparatus is freely used.

At the close of the lecture a hearty vote of thanks to the lecturer was passed.

New York Electrical Society.

The Society will give a dinner on Friday evening, May 27, at 7:30, at the St. Denis Hotel, Broadway and West Eleventh street, in celebration of its recent work and growth. The price per cover is $2.50. There is much interest in the affair, and the attendance will probably be very large. The dinner will be accompanied by music, etc., and followed by speeches from prominent men.

THE STOCK MARKET

Steady and Dull Markets.

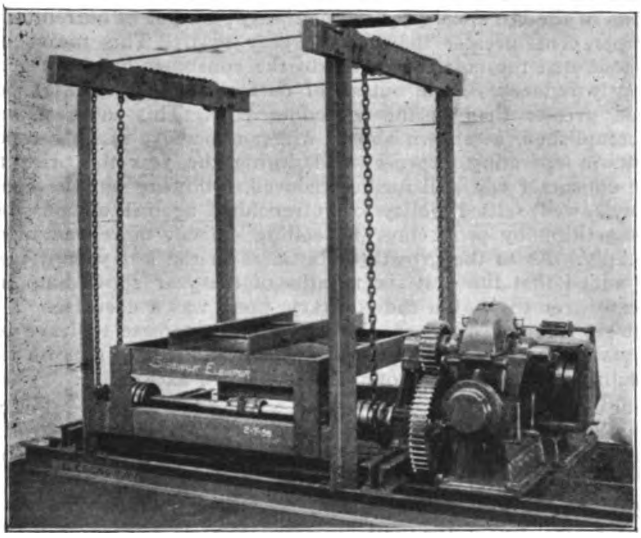
Pending the occurrence of some striking event in the field of war, the various markets of the country have remained quite steady and a trifle dull. Stocks particularly have awaited developments. During the week, 18,889 shares of Western Union were sold, around 88 to 90. General Electric, on sales of 3,237 shares, rose to 36¾. Bell Telephone in Boston was inert. New York Edison was dull at 125.

NEWS AND NOTES

Elevator for Handling Storage Batteries on Cars.

ONE of the greatest troubles experienced in operating storage battery cars in the past has been caused by the difficulty of placing the batteries on the cars, and of replacing the discharged battery with the charged. This unsatisfactory feature was entirely overcome when the battery was placed on the truck of the car instead of under the seats, and was hoisted up from below on to the truck, instead of being shoved in either at the ends or sides of the car. This new arrangement was first used on two storage battery cars which were operated on the Madison Avenue street car line in New York City about three years ago. This feature was further perfected in the equipment of The Englewood & Chicago Electric Street Railway, Chicago, Ill., and has been most successfully in operation on that road for the past eighteen months.

In the first installation a stationary elevator was used for raising the batteries to the car truck. In the Chicago installation there were two elevators placed on a large transfer car



ELEVATOR FOR HANDLING STREET CAR BATTERIES.

which ran at right angles to the street-car track, the whole apparatus being controlled by a man standing on a centre platform of the transfer car. This arrangement was fully described in The Electrical Engineer of Dec. 2, 1896.

During the past few months two of these Chicago cars have been in operation on the Grand Street Cross Town line in New York, but here it was not necessary to use such a large piece of apparatus as the transfer car in Chicago for transferring the batteries. The accompanying engraving shows an elevator which was constructed for the purpose. This elevator was placed below the street-car track, the drum shaft being at right angles to the latter. On the platform of the elevator will be noticed two short pieces of channel iron held rigid and parallel by two tie rods. The small truck on which the battery was placed in the charging pit ran on to these channel irons from a small track placed in the bottom of the pit. When the elevator was at its lowest position, the top of the channel irons was at a level with the head of the pit rail.

A charged battery would be run on to the elevator, and would then be raised by the motor shown in the cut to its position on the car truck above, where it was automatically locked. When the street car had made its appointed run, so that the battery needed recharging, the power would be brought above the elevator, an empty battery truck would be raised, and the battery lowered into the pit. A fully charged battery on this truck would then be pushed on to the elevator, and raised into position as before.

By this method of putting the batteries on the cars, several advantages are gained: 1. As the battery is placed on the car truck, no space is taken up in the body itself. This will allow of putting any sort of a body on the truck desired by the railway company. 2. There is no space taken up in the car barn by the batteries, as they are handled and charged entirely in the battery pit beneath the tracks. 3. There is no odor on the car itself from the acid fumes, and no spilling of acid in the car. 4. The battery is compact, occupying only the space between the two axles on the truck, and is in one tray, instead of two or more trays under the seats.

The operation of The Chicago & Englewood Street Railway has illustrated that a storage battery street railway is a commercial success. The batteries have now completed nearly 20,000 miles without any repairs whatever, and give promise of continued service in the future. As the operation brings down the cost of maintenance of the battery to such a low figure, the total cost per car mile will, it is predicted, compare favorably with any other system of street car propulsion.

Electricity in the Miehle Printing Press Factory at Chicago.

THE Miehle Printing Press Mfg. Co. has made several applications of electrictiy to the work in its factory at 80 North Clinton street, Chicago, which are decidedly in the line of progress, and which go to show that this concern is striving to be thoroughly up to date in its methods. The first application of electricity, aside from shop lighting, was that of driving the portable drills used for boring holes in press frames while the presses are being assembled. It is out of the question to drill many of these large frames in a drill press, as it is desirable to drill most of the holes at a time when the press is being put together. Heretofore some of these holes were drilled by hand. Others were drilled by power furnished by a kind of rope transmission from shafting overhead. Hand drilling was of course slow and expensive because of the labor involved. The rope drive was exceedingly inconvenient and cumbersome as can readily be imagined when it is considered how much work it is to arrange the driving apparatus for drilling in the endless variety of positions called for in the construction of a printing press. There is also constant trouble with the ropes slipping and wearing out. The electric motor offers a very easy solution of this drilling question. It can be put anywhere it is wanted and moved to suit the requirements. The company now has two motors devoted to this work. Each one is mounted on a small hand truck that can be wheeled around from one place to another. On the truck there is not only the motor, but the rheostat and reverse switch. The whole is enclosed in a ventilated box for protection against dirt and flying metal. From the motor to the drill the connection is made by 6 to 8 feet of flexible shafting.

The two motors now in use differ somewhat in details, though both are of the same capacity, 3 horse power. One is a compound wound Excelsior motor with Cutler-Hammer rheostat. The flexible shaft can be attached either direct to the armature shaft or to a shaft geared to the armature shaft to give considerable speed reduction and increased torque on the drill. Any other desired speed reduction can be obtained by the rheostat.

The other drill motor is a 3 horse power Gibbs, placed by Kohler Bros. It has four speeds of spindles to which the flexible shaft can be attached. The armature shaft runs 950 revolutions per minute, the next shaft 543, the next, 428, and the fourth 252 revolutions. The gears are encased in an oil tight gear case. These shafts are all 1 inch in diameter.

With these motors, holes up to 7/8-inch diameter are drilled, and holes 2½ inches in diameter are counterbored.

It is expected to put in circuit breakers to protect the flexible shafts against breaking due to drill sticking or overload.

The power circuit is 220 volts and is maintained separately from the 110 volt lighting circuit. Excelsior machines have recently been put in for both light and power.

Another new feature that this company has adopted is that of testing with an electric motor every press turned out of the factory to find the exact power it takes. This move is one that buyers of presses will appreciate very much, as in these days when no printing office is considered strictly modern unless employing electric motors for the individual driving of each press, of any size, purchasers are anxious to know in advance how much power a press will take, so that the electrical engineer of the installation can intelligently draw up his plans. The

electric motor offers by far the easiest method of testing the power required by a press. The presses will all be tested both with and without type and rollers. In this way any slight defects in the press that might cause it to run unnecessarily hard may be discovered, when otherwise they would not.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued May 17, 1898.

Alarms and Signals:—

ELECTRICAL SAFE PROTECTION SYSTEM. I. Freed, Harrisburg, Pa., 604,033. Filed June 15, 1897. Details of construction.

Conductors, Conduits and Insulators:—

APPARATUS FOR JOINING TELEGRAPH CABLES. H. Menier, Paris, France, 604,258. Filed Dec. 28, 1897. Comprises an elastic cylinder to inclose the cable joint, hollow chambers about the cylinder and means for admitting fluid pressure to the chambers to compress the cable joint.

Dynamos and Motors:—

ELECTROMAGNET HAVING ROTATING FIELDS. W. Langdon-Davies, London, England, 604,055. Filed May 23, 1896. An electromagnet having a rotating field resulting from two windings carrying current differing in phase asymmetrically arranged upon the core and inclined the one to the other at an oblique angle which is the supplement of the angle by which the currents in the two windings differ in phase.

COMMUTATOR BRUSH HOLDER. W. B. Stull, Bayonne, N. J., 604,220. Filed Feb. 12, 1898. Comprises the follower connected with the brush and lazy-tong levers at one end connected with the follower and levers at the other end to the holder, combined with means for exerting spring-pressure laterally against the sides of the levers.

Electro-Metallurgy:—

APPARATUS FOR ELECTRICALLY WORKING METALS. J. D. Bishop, New York, 604,137. Filed May 6, 1897. Particular adapted to the production of continuous lengths of electrical conductors.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. F. W. Steinacker & E. F. Cowley, Cleveland, O., 604,219. Filed April 12, 1897. A lamp of the incandescent arc type adapted for use on a constant potential or incandescent lamp circuit.

Railways and Appliances:—

ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS. W. F. Richards, Buffalo, N. Y., 604,081. Filed Sept. 16, 1897. The dynamo is driven from the car axle by a belt and the dynamo is movable toward and from the driving axle, so that the belt slips when the speed of the driving axle exceeds that which is necessary to properly drive the dynamo.

ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS. W. F. Richards, Buffalo, N. Y., 604,082. Filed Sept. 22, 1897. Similar to above.

ELECTRIC LIGHTING APPARATUS FOR RAILROAD CARS. W. F. Richards, Buffalo, N. Y., 604,083. Filed Sept. 25, 1897. Similar to above.

ELECTRIC LIGHTING APPARATUS FOR RAILROAD CARS. W. F. Richards, Buffalo, N. Y., 604,084. Filed Oct. 11, 1897. Similar to above.

ELECTRIC LIGHTING APPARATUS FOR RAILROAD CARS. W. F. Richards, Buffalo, N. Y., 604,085. Filed Oct. 14, 1898. Similar to above.

RAIL CONDUCTOR FOR ELECTRIC SYSTEMS. L. E. Walkins, Springfield, Mass., 604,098. Filed Aug. 18, 1897. Comprises the combination of several rails in end-to-end arrangement, an intermediate one consisting of two opposite longitudinally ranging metallic sections and an intermediate rail of non-conducting material supporting and insulating the sections, end portions of the intermediate rail overlying the ends of the metallic sections and serving to insulate the respective metallic side sections of their ends from the rails adjoining the ends of the intermediate sectional rail.

ELECTRIC LIGHTING APPARATUS FOR CARS. W. E. Wilhelm and W. F. Richards, Buffalo, N. Y., 604,101. Filed Oct. 23, 1897. Combines with a railway vehicle and its axle, an inclined track arranged lengthwise on the under side of the vehicle, a carriage mounted on the track, a dynamo adjustably attached to the carriage, and a frictional driving mechanism whereby the dynamo is driven from the axle.

TROLLEY FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, Ohio, 604,196. Filed Sept. 26, 1896. Consists of an overhead conductor, and a trolley arm mounted upon a car, combined with a horizontal cylindrical roller mounted upon the upper end of the trolley arm, a sleeve secured upon the roller between its ends, a rod extending through the roller and the ends of the arm and ball bearings placed upon the rod, and fitting in the ends of the roller.

Switches, Cut-Outs, Etc.:—

CIRCUIT CLOSER. W. D. Kennedy, Easton, Pa., 604,157. Filed March 25, 1895. Comprises a base, a thermostatic plate thereon, a central manual closer, a perforated guard for the thermostat, and a cap for the manual closer engaging and securing the guard on the base.

Telephones:—

TELEPHONE SWITCHBOARD PLUG. J. Taylor, Heathercliffe Helsby, England, 604,094. Filed Nov. 21, 1896. A triple contact plug embodying a single central bolt, which, with the aid of suitable nuts, binds together all the respective parts of the stem and interior so that the loosening of the nuts on this bolt enables the plug to be taken entirely to pieces.

COMBINED ANNUNCIATOR AND SPRING JACK. G. W. Sutton, New Rochelle, N. Y., 604,340. Filed April 8, 1897. Combines a switching device and an apertured pivoted shutter barring access to the same, except through the aperture whereby a plug for operating the switching device must be passed through the shutter to reset it.

REPORTS OF COMPANIES

The Chicago Edison Co.'s Annual Report.

THE statement of the Chicago Edison Company for the year ending March 31 last makes an even better showing than anticipated. Gross earnings increased about 8 per cent., while operating expenses increased less than 4 per cent. Operating expenses, in proportion to gross earnings, are now the smallest in the company's history. The way in which the company has broadened its business and at the same time, by liberal expenditures on plants, reduced operating expenses, is partially illustrated by a comparison between the figures for the last fiscal year and those for the fifteen months ending March 31, 1894, the latter including the whole World's Fair period. In the fifteen months of 1893-'94 gross earnings were $480,000 more than in the last twelve months, but operating expenses were $475,000 larger, so that in the last year the company earned practically the same amount net as in the fifteen months ending March 31, 1894. The fiscal statement, however, does not begin to show what the company has really accomplished in the way of reducing cost of production and enlarging its field. The figures as to output are much more striking. Thus in the last fiscal year the company's output of current was 70 per cent. greater than in the year 1894. This means, of course, that the cost of current to the consumer has been very greatly reduced. The output of current this year was 15 per cent. greater than in the preceding year. This increase was accomplished, as shown above, with an increase of only 4 per cent. in operating expenses and during the year the price to the consumer was still further reduced, following out the company's well settled policy of intrenching against all possible competition by producing and selling current more and more cheaply. As to the growth of business in the last year it may be added that the first six months of the year showed no increase over 1896. On the contrary, there was a decrease. The last six months, however, showed enough increase to leave receipts for the twelve months $113,255 ahead. From 1894 on the results achieved by the company are shown as follows:

Year ending March 31.	Gross.	Optg.	Earned on stk.	Per ct. optg.
1895	$1,437,042	$953,377	$328,537	66.3
1896	1,461,084	898,517	404,432	61.5
1897	1,548,608	948,934	419,340	61.3
1898	1,661,863	985,338	449,844	59.3

The last year, as compared with the preceding year, shows larger earnings, reduced proportion of operating expenses and a larger surplus after dividend requirements were met. Out of this year's surplus $40,000 was charged to depreciation reserve. The figures for 1898 and 1897 are:

EARNINGS.

	1897-98.	1896-97.	Increase.
Gross	$1,661,863	$1,548,608	$113,255
Operating expenses	985,338	948,934	36,404
Net	676,524	599,674	76,850
Interest	226,680	180,334	46,346
Earned on stock	449,844	419,340	30,504
Dividends	398,072	397,518	554

The growth of the business during the year is shown by the following statement of business connected:

Incandescent lamps	259,496
Arc lamps	5,896
Motors (horse power)	8,415
Total equivalent in 16 candle power lamps, March 31, 1898	436,083
Total equivalent in 16 candle power lamps, March 31, 1897	355,140
Increase for fiscal year	80,943

The capital stock is the same as a year ago, but the company has issued $708,000 of the new bonds during the year. The proceeds went to improvement of plants, as that item increased $922,878. These are the only important changes shown by the balance sheet. The following gives all the items for two years with comparisons:

ASSETS.	March 31, 1898.	March 31, 1897.	Changes.
Plants, real estate, etc.	$9,553,208	$8,630,330	Inc. $922,878
Work in progress, etc.	161,549	136,405	Inc. 25,144
Accounts received	211,110	197,799	Inc. 13,311
Cash	86,826	206,541	Dec. 119,715
Open accounts	48,457	......	Inc. 48,457
Total	$10,061,151	$9,171,075	Inc. $890,076

LIABILITIES.			
Capital stock	$4,975,900	$4,975,900	......
Bonds and debentures	4,458,000	3,750,000	Inc. $708,000
Accts. and notes payable	279,213	131,066	Inc. 148,147
Open accounts	......	17,842	Dec. 17,842
Depreciation reserve	240,000	200,000	Inc. 40,000
Insurance fund	28,000	20,000	Inc. 8,000
Surplus	80,038	76,267	Inc. 3,771
Total	$10,061,151	$9,171,075	Inc. $890,076

Depreciation reserve as here shown represents amounts charged out of earnings and set aside for permanent improvements to plants.

The company improved its already commanding position during the year by a number of operations which resulted in landing some small electric light companies in the hands of friendly interests, where they will be operated in harmony with the Edison Company's ideas. Thus the property formerly owned by the Chicago Illuminating Company, the Hyde Park Thomson-Houston Company, the Englewood Electric Light Company and the Western Light and Power Company, has during the year changed ownership and come into the possession of people who will be entirely in harmony with the Edison Company. In fact, President Insull of the Edison Company has been elected president of two of these smaller concerns.

A dispatch from Chicago, dated May 17, says: "The Edison interests are now in absolute control of the entire electric lighting business of the City of Chicago. They have within a few months purchased the stock of every independent electric light company in active operation in the territory bounded by South Evanston on the north, and the Indiana State line on the south, and these companies are now operating under the direction of President Samuel Insull of the Chicago Edison Company.

Among the concerns taken in are the following: Hyde Park Electric Light and Power Company, Hyde Park; Thomson-Houston Electric Light Company, Mutual Electric Light Company, People's Light and Power Company, People's Electric Light Company, Motor and Power Company, Englewood Electric Light and Power Company, Chicago Illuminating Company, Western Light and Power Company, Edgewater Electric Light Company, West Chicago Electric Light and Power Company, and Enterprise Power, Light, and Heat Company.

These companies are not to be merged with the Chicago-Edison Company, but will be consolidated into one company, under the name of the Commonwealth Electric Company, which will be controlled by the same interests as the Chicago-Edison Company.

PERSONAL

MR. E. W. ROCKAFELLOW, of the Western Electric Co., who was stationed at Camp Townsend as First Lieutenant of Company B, 47th Regiment, has been appointed Captain of Co. M, 47th Regiment, now stationed at Camp Black. Mr. Rockafellow is to be congratulated on his promotion.

SIDNEY LANIER. The appreciation of Sidney Lanier, by Th. Bentzon (Madame Blanc) which "The Living Age" presents in translation in its numbers for May 14 and May 21, is probably the fullest, most discerning and most delicate tribute ever paid to this poet, whose qualities have been imperfectly appreciated among his own countrymen.

MR. JOHN RICE, who is so well and favorably known to the carbon consuming trade, has accepted a position with the Phoenix Carbon Mfg. Co., of St. Louis. We wish Mr. Rice every success in his new home in St. Louis.

MR. J. J. MOORE, the well-known electrical engineer, and now president of the Auburn, N. Y., Electric Light Co., has just celebrated his silver wedding at Springfield, Mass. His son, J. D. Moore, is a graduate of the Massachusetts Institute of Technology, and is in the profession.

MR. E. W. LITTLE, so well known in the electrical field from his long connection with the management of leading concerns in it, has become associated with Nicoll, Herrick & Berg, the bankers and brokers, and has opened a branch office for them in the Townsend Building, 25th street and Broadway. His many friends will wish him abundant success.

LEGAL NOTES

The Condict Electric Car Controller Patent Sustained—Electric Car Co. of America and Thomson-Houston Co. vs. Hartford & West Hartford Co., et al.

Last week Judge Townsend, of the United States Circuit Court for the District of Connecticut, handed down a decision sustaining on its main points the patent granted to George H. Condict, No. 393,323. This patent refers to a car controller, originally designed for storage battery cars, so arranged that at the time of changing the connections resistances are inserted to cut down the current so as to prevent sparking, these resistances being cut out of circuit as soon as the new connection is made. The patent also shows four ways of coupling the motors in series parallel arrangements. The defendants apparatus was constructed under the von Zweigbergk patent, No. 546,664, which embodies a "dissipator."

In its opinion the Court says: "In view of all the facts proved, I find and hold that the invention of Condict is a broad one; that he is entitled to the beneficial uses of his invention as developed in the development of the art, and that defendants in thus using his combination infringe the patent. Condict was the first inventor of a practical embodiment of this system of co-operating resistances. His invention has been modified and developed to meet the exigencies of the greater voltage and other inventions in the railway trolley art.

The Court holds that claims 20, 21, 22, 27, 28, 29 and 31 of the Condict patent are infringed and orders an injunction and accounting.

The complainants, General Electric Co., were represented by Messrs. Betts, Sheffield & Betts; Messrs. Charles E. Mitchell and William F. Henney appeared for the defendants.

The Sprague Railway Motor Suspension Patent—Claims 2 and 6 Sustained by the U. S. Circuit Court of Appeals—Sprague Electric Railway & Motor Co. vs. the Union Railway Co. and Walker Co.

The United States Circuit Court of Appeals has rendered a decision in the suit brought by the General Electric Co. against the Walker Co., for infringement of the Sprague patent No. 324,892, covering the method of railway motor suspension. The claims said to be infringed read as follows:

"2. The combination of a wheeled vehicle and an electro-dynamic motor mounted upon and propelling the same, the field-magnet of said motor being sleeved upon an axle of the vehicle at one end, and supported by flexible connections from the body of the vehicle at the other end, substantially as set forth."

"6. The combination, with a wheeled vehicle, supported upon its axles by springs, of an electro-dynamic motor flexibly supported from such vehicle, and centered upon the driving-axle thereof, substantially as set forth."

"9. The combination, with a wheeled vehicle, of an electro-dynamic motor centered upon the driving-axle thereof at one end, a spring-support for that end of the motor from the truck or body of vehicle, and relieving axle wholly or partly of dead-

weight, and a spring support for the other end of motor from the truck or body of vehicle, substantially as set forth."

In an opinion written by Judge Shipman, the Court, after reviewing the case at length, holds that claims 2 and 6 are infringed, and orders an accounting on those claims. Claim 9 is held not to be infringed.

Condenser Electro-Magnets.

During the past three years an important interference contest has been pending in the United States Patent Office on one of the patents owned by the American Bell Telephone Company, and an application for patent of Mr. John T. Williams, the inventor of the "portelectric" carrier system, the subject of which is the condenser electro-magnet; that is, an electro-magnet embodying in the same structure an electrical condenser. In this device the winding of the magnet forms one electrode or plate of the condenser, while another interwound conductor forms the other electrode, the insulating material of the wires serving as the dielectric. The purpose of this invention is to suppress the evil effects of self-induction in the magnet winding, and so to quicken or sharpen the response of the armature, and is especially effective on alternating or rapidly interrupted current circuits. The case was recently finally decided in favor of Mr. Williams.

Mr. Wm. A. Rosenbaum, of New York, appeared for Mr. Williams, while Mr. W. W. Swan, of Boston, and Messrs. Pollock & Mauro, of Washington, D. C., represented the Bell Company.

Telephone Switchboard Litigation in Detroit.

The Western Electric Co. has brought suit against the Detroit Telephone Co. and W. L. Holmes to restrain them from alleged infringement of the Leroy B. Firman patent on multiple switchboards, which was recently sustained in California, but, it appears, expires in January, 1899.

TRADE NOTES & NOVELTIES

The Upton Midget Enclosed Arc Lamps.

The manufacturers of the Upton Midget enclosed arc lamps, recognizing the fact that many plants using enclosed arc lamps for alternating currents which at the present time are operated at the high frequency, may desire to change over to the low frequency current at no distant day, have so designed their lamp that it will operate on both frequencies without change of adjustment. When called for by customers the lamp is furnished so that the only change required is in the terminal connection on the lamp in the binding posts, which are properly marked. The lamps can be adjusted to take from 4 to 6½ amperes, as may be desired; that is, an average consumption of from 300 to 500 watts per hour. The Standard Thermometer & Electric Company are also prepared to equip each lamp with a reflector over the arc, and opal shade in place of an outer globe. The Standard people claim that the sales of their lamp are increasing from users all over the country on account of its steady burning and noiseless operation.

They also report that their enclosed arc series lamp for constant current circuits of from four to seven amperes has proved to be the best lamp of this type on the market. Large numbers of them are being sold for commercial lighting, and also for street service. Among recent sales for street lighting they mention the municipal lighting plants at Taunton and Hudson, Mass.; the Tecumseh Electric Light Co., Tecumseh, Mich.; Fox River Lighting Co., Green Bay, Wis.; Oshkosh Gas Light Co., Oshkosh, Wis., all of which made their purchases after thorough tests.

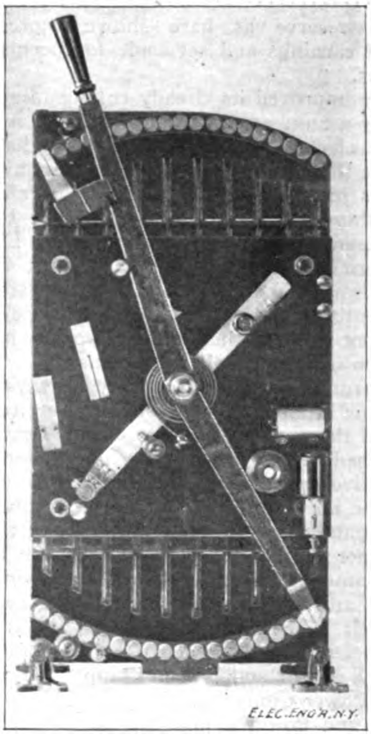
The Standard people have recently issued a new catalogue which gives full description and cuts of their enclosed arc lamps for all circuits. Copies of this catalogue will be mailed on application to the home office at Peabody or any of their branch offices mentioned elsewhere in this paper.

The Ward Leonard Printing Press Rheostat Controller.

A rheostat for accomplishing all that is desired in the control of a printing press is not an easy thing to produce as many press builders can testify. The Ward Leonard Electric Co. have devoted special attention to this work, and we illustrate herewith one of their latest forms of printing press controllers.

The rheostat occupies very little room, and can be attached on the side of a press in the most convenient place for operating it without taking up enough space to be objectionable on this score. The rheostat has 35 steps, so that all sparking at the contacts is eliminated absolutely, yet the operating lever is only moved through about 50 degrees from one extreme limit to the other. The rheostat contact lever can be left in any position and thus any resistance desired can be kept in circuit with the motor. The resistance of the rheostat is so great that when all of it is in circuit the press can be stopped under conditions of lightest load.

The movement of the rheostat lever to insert all of the resist-



WARD LEONARD PRINTING PRESS RHEOSTAT CONTROLLER.

ance causes it to engage with a separate automatic switch lever which it moves to a position in which the circuit is closed. After being thus closed the automatic switch lever is held closed under normal conditions by a shunt magnet across the full e. m. f. A vertical solenoid magnet having a plunger like the ordinary circuit breaker provides the overload safety device. Upon overload current from any cause this plunger is drawn upward by the action of magnetism acting against gravity and knocks open a switch, opening the circuit of the holding magnet, and thus causing the release of the automatic switch lever which opens the circuit, the final breaking of the current occurring on renewable carbon contacts, as shown in the illustration.

At various points around the press, as desired, push buttons are placed by which the automatic switch lever can be released by merely pushing any one of these buttons, thus instantly stopping the press. One of these buttons is also placed on the rheostat plate itself, thus providing the simplest and quickest means of opening the circuit and stopping the press.

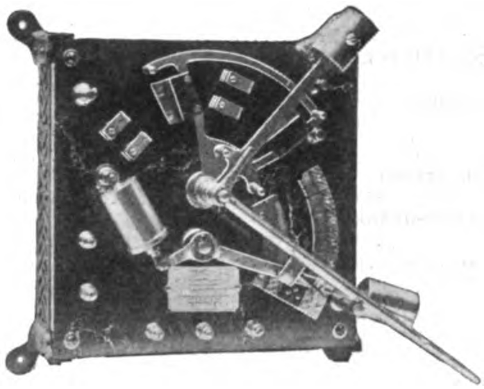
The rheostat shown in the illustration is regulating a 15 h. p. 250 volt Thresher motor upon a printing press in the establishment of Munroe & Co., of New York city.

THE PARTRIDGE CARBON CO., Sandusky, Ohio, have succeeded in producing a carbon for enclosed arc lamps which they claim is as good as the best imported carbons on the market. These carbons are now burning in the lamps of McIntire, Adams-Bagnall, Nowotny and Bergmann makes, at the Electrical Exhibition.

New Zimdars & Hunt Automatic Motor Starter.

WE illustrate herewith a new type of automatic motor starter which has just been put upon the market by Zimdars & Hunt, 127 Fifth avenue, New York. This device is extremely simple in its operation and has many features which should recommend it to prospective users of such apparatus. The various operations required to properly start a motor are accomplished automatically by the interaction of a number of suitably disposed levers, two of which are weighted.

In operating, the main arm is raised (by rope or other suitable means), and this carries the rheostat lever up over the rheostat contacts, inserting the full starting resistance into the armature circuit. Immediately the rheostat arm reaches the top contact the main knife switch is closed, the field energized and the circuit closed through the armature and its starting resistance. At the time the main switch is closed the rheostat lever is auto-



ZIMDARS & HUNT NEW AUTOMATIC MOTOR STARTER.

matically released and travels downward, under the action of gravity, over the rheostat contacts gradually cutting out the starting resistance. The rate of travel of this rheostat lever can be regulated over a wide range by a pivoted air dash-pot of improved form. The point of release can also be adjusted with relation to the time of closing of the main switch.

This starter bears evidence of careful designing throughout, the absence of springs, solenoids, and other devices of an unreliable character being especially noticeable. The details are representative of the latest and most approved practice, all contacts, for instance, being of the knife form, with those of the rheostat being capable of adjustment.

The workmanship on these articles is up to the well-known standard maintained by this firm, and calls for no further comment. For motors operating on elevator, pump, crane, blower, and such other work, these starters should be found especially desirable. On account of the simplicity of the design the firm is enabled to sell these articles at remarkably low prices. A very attractive folder, "Bulletin C 1," just issued, gives complete prices in all sizes, from ½ to 25 horse power for all voltages, and can be obtained upon request from the above firm.

The Pyramids Not in It For Longevity.

The Leclanche Battery Co., of 117 East 131st street, New York, have received the following letter from Wells & Gunde, jewelers, New Haven, Conn.:

"We have two of your Gonda cells in a self-winding clock in our store. They have been in use not quite eleven years and now they do not work as they should. The zinc and solution have been renewed two or three times, but nothing else has ever been done to them and we think there must be some trouble with the carbons. Will it be necessary to get new batteries, or can you furnish us with new carbons, and if so how much will they cost?"

The Jersey Electric Company's Standing Offer.

THE renewal of burned-out incandescent lamps and making them as good as new has been brought to such a state of perfection by the recently organized Jersey Electric Company, of 744 Broad street, Newark, N. J., that they are now making a standing cash offer for 1,000,000 or more burned-out lamps. They put in new cellulose filaments and sell the renewed lamps at a greatly reduced rate. Besides carrying on an extensive business in renewed lamps, the company purchase scrap copper, for which many uses can be found in the arts. Mr. Harry Gregory is treasurer and general manager of the company, and is well known in electrical circles. Mr. Thomas G. Westcott is general sales agent and is now establishing several large sales agencies throughout the States.

Willard Batteries in Paris.

Messrs. Sipe & Sigler have received orders for Willard batteries from the Riker Electric Motor Co., of New York, and the Fischer Equipment Co., of Chicago., for motor vehicles sold in Paris.

Berly's Universal Electrical Directory for 1898.

This excellent directory, published by H. Alabaster, Gatehouse & Co., London, covers its immense field in an admirable manner, improving yearly. There are about 1,100 pages of directory matter, including in the following sections 23,794 distinct names, as follows: British, 9,918; Continental, 7,872; American, 4,080; Colonial, 1,924. This is a gain of 1,136 names over 1897. The main groups are subdivided and classified in various ways for convenient reference, and a great deal of useful, miscellaneous information is given.

NEW YORK NOTES.

AMERICAN DISTRICT STEAM CO., of Lockport, N. Y., is constructing an exhaust heating plant at Erie Pa., which will utilize the exhaust from the Merchants and Mfr's Electric Light Co.'s station, and also that from the station of the Electric Motor Co. The supply from these two stations will be brought together and distributed through a 12-inch main for heating the principal public buildings and residences of the city. A similar plant is being constructed at York, Pa., for the Edison Electric Light Co. of that place.

MESSRS. H. B. COHO & CO. have issued an exquisite little brochure with dark green paper cover. In it they call attention to the apparatus they sell; some of their recent installations, among which may be mentioned the panel boards for the Empire Building; to their guarantee to make good any defects which appear in their installations within one year from completion; and their aim to do only high grade work, which means low operating cost, with high efficiency. Messrs. Coho & Co. are now well located in their new quarters at 30 Cortlandt street, with vastly increased facilities for conducting the growing business which has made this concern so prominent.

NEW YORK EDISON CO. reports for April gross income of $260,609, an increase of $54,466 over April, 1897; or a gross increase for the four months of $212,656 and a net increase for the four months of $73,168.

LONG ISLAND R. R. CO. is issuing this year two handsome books entitled "Unique Long Island," made up of phototones, and "Long Island," a descriptive pamphlet. The summer train schedule goes into effect June 23, and, with fine trolley service all over the western end of the island, makes this seaside resort more attractive and available than ever.

WESTERN NOTES

THE WALKER CO., of Cleveland, has arranged with Mr. W. H. Emanuel, a large machinery merchant, to represent it in Denver, with headquarters on Tremont street, opposite the Brown Palace Hotel.

ELECTRIC APPLIANCE CO. have recently concluded the general distribution of their Fan Catalogue for the season of 1898. In sending out catalogues to a very large list of buyers it is very often the case that some are overlooked. The Electric Appliance Company would be very pleased to hear from any of the trade who have not received a copy of this handsome catalogue, as they are anxious to place the same in the hands of every possible user or purchaser of fan motors.

THE OHIO ELECTRIC SPECIALTY MFG. CO., of Troy, Ohio, are making an exhibition of dynamo brushes at the Elec-

trical Exhibition, the material being in charge of Messrs. Machado & Roller.

THE new air tight open circuit battery called the Badt Hermetic Cell is receiving the approbation of all engineers and electricians who have been obliged to deal with the troublesome question of primary batteries. The oil seal, which so positively prevents the evaporation of the liquid, the creeping of salts, and the constant premature disintegration of zincs, is the latest novelty in batteries, and is a feature which strongly recommends this cell for use. The Western Electric Company of Chicago, which recently announced in its advertisement that it was headquarters for batteries of various kinds, desires to state that the Badt Hermetic Cell is also added to its list of batteries.

NEW ENGLAND NOTES

BROOKFIELD, MASS. The new power station and car house being erected by the Spencer, Warren & Brookfield Street Railway Company, at Brookfield, Mass., will have steel roof trusses and covering furnished by The Berlin Iron Bridge Company, of East Berlin, Conn. The dynamo and engine room roofs of this building will be lined with the Berlin Company's patent anti-condensation roof lining, which is now almost universally used for roofs of this nature throughout the country. It prevents the condensation of moisture from the underside of the roof covering, which, if it should collect and drop upon the machine beneath, would cause considerable damage.

PHILADELPHIA NOTES

ORDERS FOR STORAGE BATTERIES. The Electric Storage Battery Company has closed a $150,000 contract with the Government for batteries to be used in torpedo boats. Recent contracts with the Government for mines, etc., amounted to $250,000.

ERIE BALL ENGINES.—The city of Union Springs, Ala., is about to instal an electric light plant. Mr. Charles Doughty, Randolph, Mass., has recently ordered for his electric light plant at Randolph, Mass., a 200 vertical cross compound engine direct connected to 120 k. w. generator. Both these engines are furnished by the Ball Engine Co., Erie, Pa.

ADVERTISERS' HINTS

A. N. PALMER & CO., 219 E. Baltimore street, Baltimore, Md., are carrying a full stock of electrical supplies and will cheerfully send prices on all goods in that general line.

JAHL & CO., 123 Liberty street, New York, submit a list of sizes of batteries they carry in stock, one variety of which is specially made to operate spark coils.

A. L. BOGART is now located at 123 Liberty street, New York, where he will continue to supply the many gas lighting specialties manufactured by him.

HART & HEGEMAN MFG. CO., Hartford, Conn., will, on request, send a catalogue of the famous "Hart" switches, containing wiring diagrams and other useful data.

THE AUTOMATIC SWITCH CO., Baltimore, Md., have added to their "ad" a list of agents and the territory in which they are represented.

THE FULLER CO., Detroit, Mich., claim to manufacture the cheapest, most compact and efficient motor for independent service of any nature.

ALBERT B. HERRICK, E.E., is now located at 120 Liberty street, New York.

THE AMERICAN ELECTRIC HEATING CORP., Cambridge, Mass., say that it only needs a little encouragement on the part of central station managers to make electric heating apparatus fully as popular with the public as gas or oil stoves.

THE WAGNER ELECTRIC MFG. CO., St. Louis, Mo., advertise single-phase self-starting alternating current power motors.

THE C & C ELECTRIC CO., 143 Liberty street, New York, announce that they have in preparation a new bulletin treating upon electric hoists fitted with their celebrated closed type iron-clad motors, which will soon be ready for distribution.

THE K. & W. CO., Pittsfield, Mass., offer incandescent lamps at interesting figures.

THE M. C. BULLOCK MFG. CO., 1183 W. Lake street, Chicago, call attention to their central valve engines and invite requests for full information.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. JUNE 2, 1898. No. 526.

ELECTRIC LIGHTING

The Development of the Central Station.—II.[1]

BY SAMUEL INSULL, President Chicago Edison Co.

It is not my wish to address you on the scientific or technical side of central station development. I have thought it necessary to go at length into the early work of the art more for the purpose of giving you some idea of the position to which Mr. Edison is entitled as the father of central station work. My limited knowledge of the technique of the business would not permit me, even if I wished, to discuss the details of his early work, or of the early work of other experimenters; but I assure you that daily familiarity with the operation of one of the largest central stations in this country gives me a higher and higher appreciation of the simplicity and thoroughness and adaptability to all purposes of electrical distribution of the great work accomplished by the "Wizard of Menlo Park."

As a result of the experiments at Menlo Park, Mr. Edison, early in the winter of 1880, started to get together the necessary data for the establishment of a central station and distributing system in New York, in the district bounded by Wall street on the south, Nassau street on the west, Peck's Slip on the north, and South street on the east, a territory covering about 2,000 feet square. He had each house thoroughly canvassed to show the number of lights in use, the number of hoistways and elevators, and the horse power of the engines running machinery. You will find on the walls around us the blue prints of these original canvasses. On one blue print you will find an enumeration of the power in use in that district, and on the other blue print a record of the lights there used. As a result of this canvass, the Edison Electric Illuminating Company of New York was formed, and drawings prepared for a central station, which was erected at 255 and 257 Pearl street, the capacity of the station being 2,000 horse power, and the district fed by a system of half-round copper mains and feeders, the mains being enclosed in lengths of iron pipe and insulated by a bituminous compound, each length of main being between twenty and twenty-one feet, so that it was possible to take off a service at each house.

Time will not permit me to go into the details of construction of this, the first central distribution system. You will see, by referring to the outline drawings of the station which I have with me, that the boilers were placed down below and were of the horizontal water-tube type, made by Babcock & Wilcox, carrying a pressure of 125 pounds, the steam machinery and dynamos being of the direct connected type and placed on a steel structure not dissimilar to that of some portions of the elevated railroad structure in New York.

Great care was taken in figuring out the system of mains and feeders, an immense plot of the district being represented by a series of resistances showing in miniature the probable consumption of current in the various parts of the district. It should be remembered that the path to be followed was practically unknown, that electrical distribution on a large scale was as much of a hidden secret as an unexplored continent, and the remarkable thing is that this first experimental system was a practical success and a return on the money invested was being earned before electricians at home and abroad would recognize the success of the undertaking. It is but natural that many devices were used which were subsequently absolutely discarded. For instance, an elaborate system of resistances placed in series with the feeders was employed for maintaining an even pressure, entailing a considerable waste of energy. The lamp employed was not more than one-half as efficient as that used to-day, while the cost of manufacture was many times greater, and it had not one-quarter of the life of the present commercial incandescent lamp.

It might be well to pause for a moment and picture the condition of the art at that time: I refer to the winter of 1880. The plans for the central station were completed, the details of construction of the conductors in the street were all on paper, the dynamos and electrical instruments had no existence except on the draughting board, practically nothing was known of modern methods of insulation or house wiring, the socket and switch in use to-day had not been thought of, the miscellaneous devices now considered necessary in connection with house wiring had not been considered. In addition to the development of the system and its installation, manufacturing establishments had to be created in which to manufacture the first material needed, and Mr. Edison and his corps of assistants had to abandon the experiments of the laboratory and the designing of the draughting room to equip and manage shops in which to manufacture the apparatus necessary, from the generator to the lamp. Others have followed the beaten track, others have improved upon the methods employed, but the conception of the system, the perfecting of the original apparatus, its manufacture, its installation, and its early operation were all borne by an enthusiastic but small band of workers having an almost idolatrous belief in their chief as the pioneer of this great industry.

I have brought with me to-night a photograph of the original direct connected steam generator known as the "Jumbo" machine, used in the Pearl street station, composed of an engine manufactured by Armington & Sims, of Providence, R. I., of the single cylinder type, running at a speed of 350 revolutions, with what is practically the old form of Edison bipolar machine changed from a vertical to a horizontal position, the armature instead of being wound with coils of wire, being built up of copper discs and bars. If you will glance from this to the picture of a modern central station unit composed of a compound, triple, or quadruple expansion engine, with a multipolar dynamo connected directly on the engine shaft, you will find that the same broad engineering idea is alike apparent in the earliest and latest central station unit. The improvements in dynamo manufacture have enabled us to use lower speed engines, but the broad principle of direct connection is alike the same in both. That we should come back to exactly what Mr. Edison used in the earliest central station work is no mean tribute to him as an engineering authority.

The delay which necessarily occurs in carrying every new enterprise to a financial success acted as a wet blanket on central station development. Efforts were made to cheapen construction when it was found that capitalists in large cities were unprepared to risk their money in the enterprise. The apparatus was adapted to the requirements of smaller communities, and, as a result, a number of small stations were established throughout the country, especially in Pennsylvania, Ohio and Massachusetts. The development of the central station business for several years was confined to this class of work. The service was far from reliable, owing mainly to the necessity of doing the cheapest possible engineering and construction in order to meet the necessities of the slim exchequers of those who were bold enough to embark their capital in this business; but the Pearl street station, started on September 5, 1882, with 5,500 lamps, rapidly developed, and in the fourteenth month of continuous running had 508 customers, wired for 12,732 lamps. Comparatively little work was done in central station lighting in Europe. A small station was started in Dijon, France, in June, 1883, and in the same year an installation was made in Santiago, Chile; in Milan, Italy; on Holborn Viaduct, London, and in Manchester.

The success of the Pearl street station resulted in the extension of the New York system and the building of two stations uptown in New York, one in Twenty-sixth street, and the other in Thirty-ninth street. This was followed by a station in Boston and another in Brooklyn. In 1887 the building of the first station in Chicago was started, the average load, as shown by the composite ampere curves of that station, which I have with me, being not much over 500 amperes for the year 1888. These

[1]Through the courtesy of Mr. Insull and of the Purdue University, we are able to present our readers with the text of a lecture delivered on May 17, before the School of Electrical Engineering at Lafayette, Ind. An illustrated edition of the lecture will be published by the University.

latter stations, the two in New York, the one in Boston and the one in Chicago were equipped with high speed engines belted to Edison bipolar dynamos of the Siemens armature type, in some cases the engines and dynamos being on the same floor, in other cases the engines being belted to the dynamos on the floor above. Numerous other stations were started, so that by 1890 upwards of sixty cities were equipped with the direct current low tension system, all of which, and numerous others, are to-day so remunerative that their securities are considered among the most desirable local investments, especially in cities of the first and second rank.

The success of the low tension system was followed by the introduction of the alternating system, using high potential primaries with the converters at each house, reducing, as a rule, from 1,000 down to either 50 or 100 volts. I am not familiar with the early alternating work, and had not, at my disposal, sufficient time in preparing my notes to go at any length into an investigation of this branch of the subject; nor do I think that any particular advantage could have been served by my doing so, as it has become generally recognized that the early alternating work with a house-to-house converter system, whilst it undoubtedly helped central station development at the time, proved very uneconomical in operation and expensive in investment, when the cost of converters is added to the cost of distribution. The large alternating stations in this country have so clearly demonstrated this that their responsible managers have, within the last few years, done everything possible, by the adoption of block converters and three-wire secondary circuits, to bring their system as close as they could in practice to the low-tension direct-current distribution system. I do not want to be understood as undervaluing the position of the alternating current in central station work. It has its place, but to my mind its position is a false one, when it is used for house-to-house distribution with converters for each customer. The success of the oldest stations in this country, and the demonstration of the possibilities of covering areas of several miles in extent by the use of the three-wire system, resulted in much capital going into the business. One of the earliest stations of a really modern type installed on either side of the Atlantic, was built by the Berlin Electricity Works. The engineers of that station, while recognizing the high value of the distributing system, went back to Edison's original scheme of a compact direct connected steam and electric generator, but with dynamos of the multipolar type designed and built by Siemens & Halske, of Berlin, the engines being of vertical marine type.

This was followed by the projecting in New York of the present Duane street station, employing boilers of 200 pounds pressure, triple and quadruple expansion engines of the marine type, and direct connected multipolar dynamos. Almost immediately thereafter, the station in Atlantic avenue, Boston, somewhat on the same general design so far as contents is concerned, was erected. In 1891 a small station, but on the same lines, was projected for San Francisco, and in 1892 the present Harrison street station of the Chicago Edison Company was designed, and benefiting by the experience of Berlin, New York and Boston, this station produces electric current for lighting purposes probably cheaper than any station of a similar size anywhere in this country.

It is not necessary for me to go into detail in explanation of the modern central station. You are all doubtless quite familiar with the general design, but if you will examine the detail drawings of the Harrison street station, which I have brought with me, you will find that every effort has been made to provide for the economical production of steam, low cost of operating, good facilities for repairs and consequently low cost, and for permanency of service. You have but to go into any of the modern central stations in midwinter, to see them turning out anywhere from 10,000 to 30,000 amperes with a minimum of labor, to appreciate the fact that central station business is of a permanent and lucrative character.

To go back to the question of alternating currents, the work done in connection with the two-phase and three-phase currents and the perfection of the rotary transformer has resulted in introducing into central station practice a further means of economizing the cost of production—by concentration of power. According to present experience, it is (except in some extraordinary cases) uneconomical to distribute direct low tension current over more than a radius of a mile and a half from the generating point. The possibility of transmitting it at a very high voltage, and consequently low investment in conductors, has resulted in the adoption of a scheme, in many of the large cities, of alternating transmission combined with low tension distribution. The limit to which this alternating transmission can be economically carried has not yet been definitely settled, but it is quite possible even now to transmit economically, from the centre of any of our large cities to the distant suburbs, by means of high potential alternating currents, distributing the current from the sub-centre of distribution by means either of the alternating current itself and large transformers for a block or district, or else if the territory is thickly settled, by means of a system of low tension mains and feeders, the direct current for this purpose being obtained through the agency of rotary transformers.

There are various methods of producing the alternating current for transmission purposes. In some cases the generators are themselves wound for high potential; in others they are wound for eighty volts, and step-up transformers are used, carrying the current up to whatever pressure is desired, from 1,000 to 10,000 volts. In other cases, dynamos are used having collector rings for alternating current on one side and a commutator for direct current on the other side of the armature, thus enabling you, when the peak in two districts of a city comes at two different times, to take care of this peak by means of the same original generating unit, furnishing direct low tension current to the points near the central station, and alternating current to the distant points. In other cases, where a small amount of alternating current is required on the transmission line, it has even been found economical to take direct current from a large unit, change it by means of a rotary transformer into alternating current, step up from 80 to, say, 2,000 volts, go to the distant point, and step down again to 80 volts alternating, and then convert again by means of a rotary transformer into a low potential direct current.

The introduction of alternating current for transmission purposes is probably best exemplified in large cities, in the station recently erected in Brooklyn, where alternating current is produced and carried to distant points, and then used to operate series arc light machines run by synchronous motors, the low tension direct current network being fed by rotary transformers, and alternating circuits arranged with block converters, and even in some cases separate converters for each individual customer in the scattered districts.

It would be very interesting to go at length into the details of cost in this, the latest development of central station transmission, but time will not permit, nor have I the time at my disposal to go at length into the central station business as developed by the electric street railways now so universally in use, or another phase of the business as exemplified by the large transmission plants, the two greatest examples of which, in this country, are probably those at Niagara Falls, N. Y., and Lachine Rapids, near Montreal. So far as street railways and power transmission are concerned, I would draw your attention to the fact that the same underlying principle of multiple-arc mains and feeders originally conceived by Mr. Edison is as much a necessity in their operation as it is in the electric lighting systems, whether those systems be operated on the old two-wire plan, the three-wire plan or by means of alternating currents.

Passing from a review of central station plants and distribution system naturally brings us to the operating cost and the factors governing profit and loss of the enterprise. In considering this branch of the subject, I will confine my remarks to the business as operated in Chicago by the company with which I am connected.

Our actual maximum last winter came on the 20th of December, our load being approximately 12,000 h. p. A comparison of the figures of maximum capacity and maximum load of last winter shows that we had a margin in capacity over output of about 20 per cent. The load curves shown this evening represent the maximum output of last winter (December 20), an average summer load last year (June 4), and an average spring load of this year (May 2). For our purposes we will assume the maximum capacity of the plant and the maximum load of the system to be identical. The maximum load last winter occurred, as I have stated, on December 20, about 4.30 o'clock in the afternoon, and lasted less than half an hour. It should be borne in mind that the period of maximum load only lasts for from two to three months, and that the investment necessary to take care of that maximum load has to be carried the whole year. It should not be assumed from this statement that the whole plant

as an earning factor is in use 25 per cent. of the year. The fact is that, during the period of maximum load, the total plant is in operation only about 100 hours out of the 8,760 hours of the year; so that you are compelled, in order to get interest on your investment, to earn the interest for the whole of the year in about 1½ per cent. of that period, on about 50 per cent. of your plant.

This statement must bring home to you a realization of the fact that by far the most serious problem of central station management, and by far the greatest item of cost of your product, is interest on the investment. It may be that the use of storage batteries in connection with large installations will modify this interest charge, but even allowing the highest efficiency and the lowest cost of maintenance ever claimed for a storage battery installation, the fact of high interest cost must continue to be the most important factor in calculating profit and loss. This brings home to us the fact that in his effort to show the greatest possible efficiency of his plant and distribution system, it is quite possible that the station manager may spend so much capital as to eat up many times over in interest charge the saving that he makes in direct operating expenses. It is a common mistake for the so-called expert to demonstrate to you that he has designed for you a plant of the highest possible efficiency, and at the same time for him to lose sight of the fact that he has saddled you with the highest possible amount of interest on account of excessive investment. Operating cost and interest cost should never be separated. One is as much a part of the cost of your current as the other. This is particularly illustrated in connection with the use of storage batteries. Those opposed to their use will point out to you that of the energy going into the storage battery only 70 per cent. is available for use on your distribution system. That statement in itself is correct; but in figuring the cost of energy for a class of business for which the storage battery is particularly adapted, the maximum load, that portion of your operating cost affected by the 30 per cent. loss of energy in the battery, forms under 4½ per cent. of your total cost, and it must be self-evident, in that case at least, that the 30 per cent. loss in the storage battery is hardly an appreciable factor in figuring the operating cost of your product. So far as I have been able to ascertain, it would appear to be economical to use storage batteries in connection with central station systems, the peak of whose load does not exceed from two to two and one-half hours.

In order to illustrate the important bearing which interest has on cost, I have prepared graphical representations of the cost of current, including interest under conditions of varying load factors. For the purpose of this chart I have assumed an average cost of current, so far as operating and repairs and renewals and general expense are concerned, extending over a period of a year, although of course these items are more or less affected by the character of the load factor. For the purpose of figuring interest, I have selected seven different classes of business commonly taken by electric light and power companies in any large city. Take, for instance, an office building. It has a load factor of about 3.7 per cent., that is, the average load for the whole year is 3.7 per cent. of the maximum demand on you for current at any one time during that period; or, to put it another way, this load factor of 3.7 per cent. would show that your investment is in use the equivalent of a little over 323 hours a year on this class of business. This is by no means an extreme case. You can find in almost every large city customers whose load factors are not nearly as favorable to the operating company, their use of your investment being as low as the equivalent of 75 or 100 hours a year. Take another class of business, that of the haberdasher, or small fancy goods store. As a rule these stores are comparatively small, with facilities for getting a large amount of natural light and little use for artificial light. The load factor as shown by the chart is about 7 per cent., the use of your investment being not quite twice as long as that of the office building. Day saloons show an average of 16 per cent. load factor; cafetiers and small lunch counters about 20 per cent., whilst the large dry goods stores, in which there is comparatively little light, have a load factor of 25 per cent., and use your investment seven times as long per year as the office building. Power business naturally shows a still better load factor, say 35 per cent., and the all-night restaurant has a load factor of 48 per cent.

You will see from this that the great desideratum of the central station system is, from the investors' point of view, the necessity of getting customers for your product whose business is of such a character as to call for a low maximum and long average use. This question of load factor is by all means the most important one in central station economy. If your maximum is very high and your average consumption very low, heavy interest charges will necessarily follow. The nearer you can bring your average to your maximum load the closer you approximate to the most economical conditions of production, and the lower you can afford to sell your current. Take, for instance, the summer and winter curves of the Chicago Edison Company. The curve of December 20, 1897, shows a load factor of about 48 per cent.; the curve of May 2, 1898, shows a load factor of nearly 60 per cent. Now, if we were able in Chicago to get business of such a character as would give us a curve of the same characteristics in December as the curve we get in May; or, in other words, if we could improve our load factor, our interest cost would be reduced, an effect would be produced upon the other items going to make up the cost of current, and we probably could make more money out of our customers at a lower price per unit than we get from them now.

Many schemes are employed for improving the load factor, or, in other words, to encourage a long use of central station product. Some companies adopt a plan of allowing certain stated discounts, providing the income per month of each lamp connected exceeds a given sum. The objection to this is that it limits the number of lamps connected. Other companies have what is known as the two-rate scheme, charging one rate for electricity during certain hours of the day and a lower rate for electricity used during the balance of the day, using a meter with two dials for this purpose. Other companies use an instrument which registers the maximum demand for the month, and the excess over the equivalent of a certain specified number of hours monthly in use of the maximum demand is sold at greatly reduced price. The last scheme would seem particularly equitable, as it results in what is practically an automatic scale of discounts based on the average load factor of the customers. It does not seem to be just that a man who only uses your investment, say, 100 hours a year, should be able to buy your product at precisely the same price as the man who uses your investment, say, 3,000 hours a year, when the amount of money invested to take care of either customer is precisely the same. Surely the customer who uses the product on an average thirty times longer than the customer using it for only 100 hours is entitled to a much lower unit rate, in view of the fact that the expense for interest to the company is in one case but a fraction per unit of output of what it is in the other. This fact is illustrated by the interest columns on the graphic chart already referred to. Supposing that the central station manager desired to sell his product at cost, that is, an amount sufficient to cover his operating, repairs, and renewals, general expense, and interest and depreciation, he would have to obtain from the customer having the poorest load factor, as shown on the load chart, over four times as much per unit of electricity as it would be necessary for him to collect from the customer having the largest load factor. No one would think of going to a bank to borrow money and expect to pay precisely the same total interest whether he required the money for one month or for twelve; and for the same reason it seems an absurdity to sell electricity to the customer who uses it but a comparatively few hours a year at the same price at which you would sell it to the customer using it ten hours a day and three hundred days a year, when it is remembered that interest is the largest factor in cost, and the total amount of interest is the same with a customer using it but a few hours a year as it is with the customer using it practically all the year around.

I have dwelt thus at length on the question of interest cost in operating a central station system, not alone for the purpose of pointing out to you its importance in connection with an electrical distribution system, but also to impress upon you its importance as a factor in cost, in fact, the most important factor in cost in any public service business which you may enter after leaving this institution. Most of the businesses presenting the greatest possibilities from the point of view of an engineering career, are those requiring very large investment and having a comparatively small turn-over or yearly income. Of necessity in all enterprises of this character, the main factor of cost is interest, and if you intend following engineering as a profession, my advice to you would be to learn first the value of money, or, to put it in another way, to learn the cost of money.

Before leaving this question of interest and its effect upon cost, I would draw your attention to the fact that while interest

is by far the most important factor of cost, it is a constantly reducing amount per unit of maximum output in practically every central station system. When a system is first installed, it is the rule to make large enough investment in real estate and buildings to take care of many times the output obtained in the first year or so of operation. As a rule the gererating plant from the boilers to the switchboard is designed with only sufficient surplus to last a year or so. In the case of the distributing system the same course is followed as in the case of real estate and buildings, with a view to minimizing the ultimate investment. Mains are laid along each block facing, feeders are put in having a capacity far beyond the necessity of the moment, consequently interest cost is very high when a plant first starts, except, as I have stated, in the case of the machinery forming the generating plant itself. As the business increases from year to year the item of interest per unit of maximum output consequently will constantly decrease, owing to the fact that each additional unit of output following an increase of connected load increases the divisor by which the total interest is divided. The result is from year to year the interest cost of each additional unit of maximum output is a constantly reducing amount, and consequently the average interest cost of each unit of maximum output should, in a well regulated plant, grow less from year to year until the minimum interest cost per unit is reached. This minimum interest cost is reached when the capacity of the whole system and the total units of output at maximum load are identical, although of course it will always be necessary to have a certain margin of capacity over possible output, as a factor of safety.

This same rule, although to a less extent, applies to the operating and general expense cost, that is, the cost other than interest. To particularize, the manager's salary and other administrative expenses do not increase in proportion to maximum output of station; therefore the cost of administration per unit of output, if the business is in a healthy condition, must be from year to year reduced. There are a great many other expenses that are not directly in proportion to output, and these follow the same rule. In a well-run plant the percentage of operating expenses to gross receipts will stand even year after year, whilst the income per unit of output will be constantly reduced. This is an excellent evidence of the fact that the cost per unit of output is constantly being reduced, as, if it were not, the percentage of expenses to gross receipts would be increased in direct proportion to the reduction in price.

Moreover, it should be borne in mind that there are many difficulties in the way of universal use of electric energy from a central station system. It is the rare exception to find a house not piped for gas and water. In the case of the latter it is almost invariably the rule that owners are compelled to pipe for water, under the sanitary code of the municipality. On the other hand, in a large residential district, it is the exception to find a house wired for electric light, consequently the output of current per foot of conductor is at the present time very low as compared with the output of gas per foot of gas pipe in any of the large cities. The expense of wiring (which must of necessity be borne by the householder) is large, and it is often a barrier to the adoption of electric illumination, but as the rule to wire houses becomes more general, the output per foot of main will constantly increase, and therefore the interest per unit of output per foot of main will constantly decrease. This same rule will apply in the case of expenses in taking care of and repairing the distribution system, although to not so great an extent.

If you will take into account these various factors constantly operating toward a reduction of operating and general expense cost, and interest cost, the conclusion must necessarily be forced upon you that the price at which current can be sold at a profit to-day is in no sense a measure of the income per unit which it will be necessary for central station managers to obtain in the future. In 1881-2 it was difficult to make both ends meet with an income of 25 cents per kilowatt hour; to-day there are many stations showing a substantial return on their investment, whose average income does not exceed 7 cents per kilowatt hour, showing 70 per cent. reduction in price in less than two decades. How far this constant reduction in cost, followed by a constant reduction in selling price, will go, it is difficult to determine; but if so much has been accomplished during the first twenty years of the existence of the industry, is it too much to predict that in a far less time than the succeeding twenty years electric current for all purposes will be within the reach of the smallest householder and the poorest citizen? But few industries can parallel the record already obtained. If you will trace the history of the introduction of gas as an illuminant you will find that it took a much longer time to establish it on a commercial basis than it has taken to establish most firmly the electric lighting industry. All the great improvements in gas, the introduction of water gas, the economizing in consumption by the use of the Welsbach burner, have all been made within the time of those before me, and yet, notwithstanding that when these gas improvements started the electric lighting business was hardly conceived, and certainly had not advanced to a point where you could claim that it had passed the experimental stage, notwithstanding this, the cost of electrical energy has decreased so rapidly that to-day there are many large central station plants making handsome returns on their investments at a far lower average income per unit of light than the income obtained by the gas company in the same community. In making my calculations which have led me to this conclusion, I have assumed that 10,000 watts are equal to 1,000 feet of gas. This comparison holds good, providing an incandescent lamp of high economy is used as against the ordinary gas burner. To make a comparison between electric illumination and incandescent gas burners, such as the Welsbach burner, you must figure on the use of an arc lamp in the electric ciruit instead of an incandescent lamp, which is certainly fair when it is remembered that incandescent gas burners are, as a rule, used in places where arc lamps should be used if electric illumination is employed.

With such brilliant results obtained in the past, the prospects of the central station industry are certainly most dazzling. Whilst the growth of the business has been phenomenal, more especially since 1890, I think it can be conservatively stated that we have scarcely entered upon the threshold of the development which may be expected in the future. In very few cities in the United States can you find that electric illumination exceeds more than 20 per cent. of the total artificial illumination for which the citizens pay. If this be the state of affairs in connection with the use of electricity for illuminating purposes, and if you will bear in mind the many other purposes to which electricity can be adapted throughout a city and supplied to customers in small quantities, you may get some faint conception of the possible consumption of electrical energy in the not far distant future. Methods of producing it may change, but these methods cannot possibly go into use unless their adoption is justified by saving in the cost of production, a saving which must be sufficient to show a profit above the interest and depreciation on the new plant employed. It is within the realms of possibility that the present form of generating station may be entirely dispensed with. It has already been demonstrated experimentally that electrical energy may be produced direct from the coal itself without the intervention of the boiler, engine and dynamo machine. Whether this can be done commercially remains to be proved. Whatever changes may take place in generating methods, I should, were I not engaged in a business which affords so many remarkable surprises, be inclined to question the possibility of any further material change in the distributing system. Improvements in the translating devices, such as lamps, may add enormously to the capacity of the distributing system per unit of light; but it does seem to me that the system itself, as originally conceived, is to a large extent a permanency. Should any great improvements take place in the medium employed for turning electrical energy into light, the possible effect on cost, and consequently selling price, would be enormous.

The 220 Volt Lamp in Practice.

BY J. C. FISH.

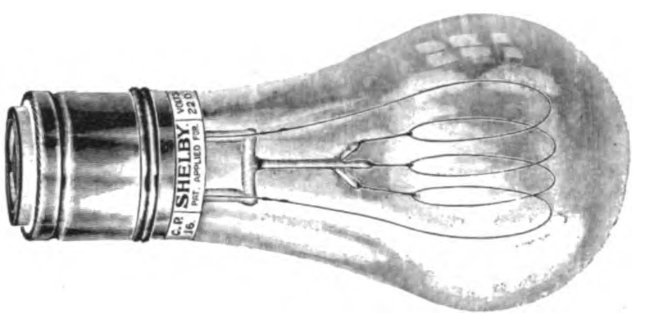
WE have been interested in an article which appears in the current issue of your valuable journal, on page 487, entitled "English Experience with 220 Volt Lamps," which points out the difficulties experienced in the use of lamps of high voltage, as discovered and experienced by Mr. Binswanger Byng, and described by him in a paper read before the London Institution of Electrical Engineers.

It is true that the lamp manufacturers in all parts of the world have been compelled, in order to meet the wishes of their trade, to supply 220 volt lamps at given candle powers in bulbs which should not be noticeably different from the bulbs used in the ordinary 110 volt lamp. The difficulties as shown by Mr. Byng are difficulties that have made it to a degree unsatisfactory to make high voltage lamps. The Shelby Electric Co., however, have secured patents on a type of lamp which permits them to use a

flashed carbon, made in the manner that is in certain respects different from other carbons and still permit it to be stowed away in the small bulb. This company is treating or flashing all of the filaments they use in 220 volt lamps, and consequently they get a much more even result at higher efficiency and less drop in candle power than it has been possible to attain when making lamps under the old principles.

A reference has been made to tests made by Mr. Robertson, which show that the unflashed carbon loses in candle power about 42 per cent., and in efficiency about 35 per cent. Tests made by The Shelby Electric Co. on various makes of 220 volt lamps substantiate the statements made by Mr. Robertson, and tests made on the treated carbons used by this company show that a lamp of 220 volts can be made that will give just as good satisfaction in regard to life, efficiency and maintenance of candle power as it is possible to obtain with any lamp of 110 volts

The accompanying engraving illustrates how the "Shelby" lamp is made, showing that the disadvantages, as stated in the article referred to, although conceded to be general, have been overcome by the Shelby Company. The separation between the leading-in wires is in excess of ½ inch, and thus the difficulty



SHELBY 220-VOLT LAMP.

referred to by Mr. Byng as a vital one, is overcome. Electrostatic effects which Mr, Byng truthfully stated increased with the voltage, have also been overcome by insulating the leading-in wires throughout, and consequently the "Edison effect or leakage current," which leads to short circuiting, is entirely overcome.

In the tests made by The Shelby Electric Company it has been demonstrated very thoroughly that a paste connection or deposit of paste on the anchors, can not be satisfactorily used in a high voltage lamp, as the carbon is necessarily so thin that the least amount of oxygen permitted to enter the lamp will certainly destroy it. This has also necessitated the use of platinum wire for anchors. A 220 volt lamp must be made in a manner that provides for all of the disadvantages as set forth in Mr. Byng's paper, but as the Shelby lamps embody principles by which all of these disadvantages have been overcome, we think it is not fair to say that 220 volt lamps are not a success.

The Shelby Electric Co., it may be added, have produced for experimental purposes, a number of 500 volt lamps, and they claim that patents which they have covering the manner of making these lamps will protect them from being met in competition should the time ever come when a 500 volt lamp should be needed.

Large Power Transmission Plant in Mexico.

The Westinghouse Electric and Manufacturing Company has closed a contract for twenty 300 h. p. two-phase generators, with switchboard and raising transformers, for the San Ildefonso-Tlalnepantla Transmission system, near the City of Mexico. The current is to be utilized for lighting and power in the city. The generators are to be direct-connected to water wheels. Transmission will be three-phase at 32,000 volts. The terms of the contract call for its completion by March 1, 1899. The introduction of so large an installation of American apparatus marks a long step forward in the electrical development of the abundant sources of water power in Mexico.

THE SPANISH SKETCHES by Pierre Loti, which "The Living Age" is printing in an excellent translation made for its pages by William Marchant, exhibit the picturesque descriptive powers of that charming writer at their best. One sketch in the first group gives a glimpse of the Queen Regent of Spain.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—XII.

BY A. E. DOBBS.

CABLE TERMINALS.

OF course all cables must have means for connecting the cable conductors to the lines outside or in some cases changing conductors from one cable to another.

There are only about two or three forms of cable terminals in common use, and one of the oldest of these is shown in Fig. 37.

In this terminal the top, front and back are made of hardwood, the two sides, D, being usually constructed of hard rubber,

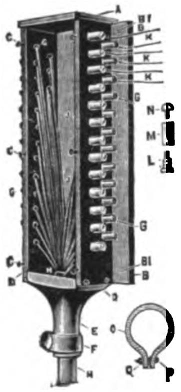
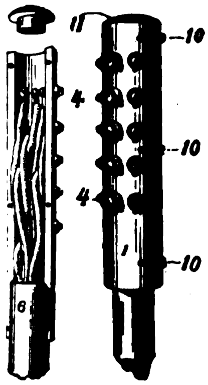


FIG. 37.



FIGS. 38 AND 38a.

in which are mounted the binding posts, c, by means of which a moisture-proof connection is established. The terminal is fastened against the back of the cable box, the end of the cable is

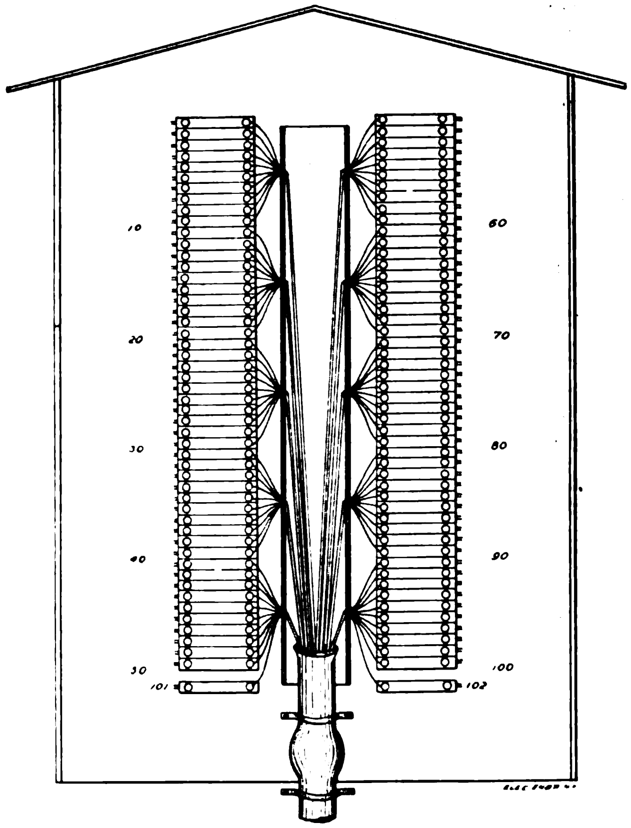


FIG. 39.

passed through the grip, E, and held there by the band, F (this can be soldered by a wiped joint if preferred). The cable conductors are then spread out, the necessary amount of insulation

[1]Figs. 37 and 38 are reproduced by permission from the handbook of the Standard Underground Cable Co., Pittsburg, Pa.

stripped off, and the wire passed through the back of binding post, which is shown in detail at L, M, U, and thus connection made to the wires outside.

Another form of this cable is simply a cast-iron box, with the back, sides, top and bottom in one piece, and the front in another, with a thin soft rubber strip underneath to make the joint airtight, the binding-posts being bushed with hard rubber. This is a very strong and substantial head. In both these forms it is common to fill part or all of the head with insulating compound poured in hot. The wires are frequently soldered to the binding-posts on the inside.

The tubular terminal (Figs. 38 and 38a) is considerably cheaper than the above mentioned, and its simplicity, lightness, and the small space it occupies, makes it very popular in many places.

It is composed of three parts; a split tube and a cap. One of these parts contains the binding posts, which after the end of the cable is stripped back is fitted down over it up nearly to the bottom posts. Alongside of each binding screw is a small hole in the rubber tube, through which the wire is pushed and connected to the lower part of the post outside, instead of inside the terminal, the line wire being fastened to the upper part.

After all these connections are made, the other half of the tube is fitted on and held in place by screws, and an insulating compound such as ozite or a mixture of rosin and beeswax is poured in until full, and the cap fitted on while it is still warm, thus sealing it up tight. Note—In pouring these compounds into the cable keep them hot till all air bubbles cease to rise, for then only is all dampness removed.

Fig. 39 shows a design by the writer, which, however, is not new. The cable is stripped back from the end as in making a cable joint; rubber insulated wire is then connected and soldered to the paper covered conductors, the wires being long enough to reach the binding posts. A lead sleeve is then slipped on long enough to cover all the joints, with room to spare, after which

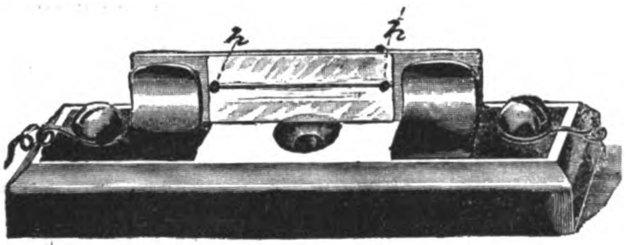


FIG. 40.

the sleeve is soldered on with a wiped joint and filled full and running over with hot insulating compound, which must be of a nature that will harden when cool.

The wires are distributed by means of two parallel wooden strips set up on edge and fastened to the back of the box, the wires being distributed directly to the line terminals without the intervention of binding posts.

These wooden strips, after all holes are bored, should be plunged into boiling paraffine, or thoroughly coated with P. & B. paint, though ordinary asphaltum or shellac will answer.

For convenience in counting, the wires in the illustration are divided into groups of 10 each. A ⅜-inch hole will generally be big enough for 10 wires.

COUNTING TERMINALS, ETC.

The system of connecting and numbering the posts on cable terminals should be uniform throughout the plant, the following being the usual way. For terminal posts on the side, Fig. 37.

Left Side.	Right Side.
●——— 1	●——— 51
●—— 2	●—— 52
●——— 3	●——— 53
●—— 4	●—— 54
●——— 5	●——— 55
●—— 6	●—— 56

It will be observed that most of these terminals are fitted up with 102 or 104 posts, in which case it is better to have the 26th post on each row regarded as an extra and called 101 and 102 respectively; this keeps the rows in multiples of 25 and facilitates counting, the same idea being shown in Fig. 39.

With tubular and some cast-iron terminals with four rows of posts down the front, the counting begins at the left hand row, and counts straight downward, except as to the 26th and 101st posts, which are left for 101 and 102, thus keeping each row ending on some multiple of 25. Follow a systematic method in keeping the pairs together, as 1—2, 3—4, 5—6, or 1 to 51, 2—52, 3—53, etc.; then if necessary to use metallic circuits, the pairs can be easily found and kept together.

In many places where cables are comparatively short, as at office poles, one side of each pair is connected to a bus-bar in the box, which is connected to the common return wire, thus keeping each circuit separate and full metallic out to the box, then, if a metallic circuit is needed, the conductor is simply disconnected from the bus-bar and connected directly through. This method is very much used in the latest work now being done. It has the merit of preventing a great deal of cross talk in the office end of the lines. With a paired cable there will be a tendency towards cross talk if the pair is run as two

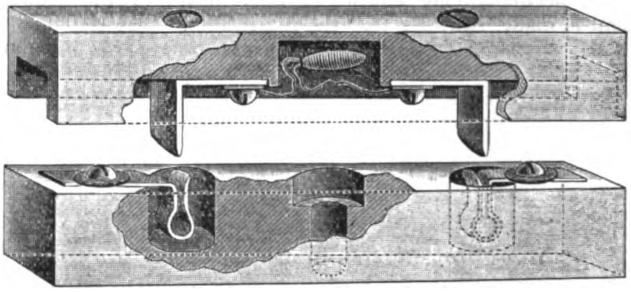


FIG. 41.

single lines, although it should be confined to those two only, if the cable is all right otherwise.

Speaking of those mixtures of rosin, beeswax and paraffine, I have not given the proportions of each because they have to be changed to suit the different conditions. In cable heads, for instance, harden by putting in more rosin, while on cable joints they should be soft. A few minutes experimenting will give the right proportion.

FUSES AND LIGHTNING ARRESTERS.

Fuses are used to open the circuit in case there is an excess of current on the line which might destroy the instruments. The best and most convenient types of fuses I know of are those shown

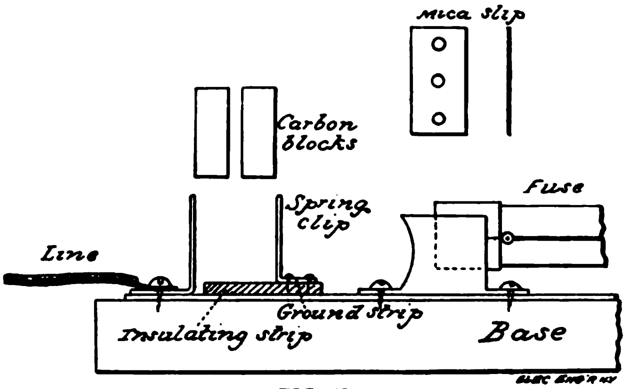


FIG. 42.

in Figs. 40 and 41. In Fig. 40 it is merely a mica strip, with thin sheet copper bent around the ends to which the fuse is soldered. There are two holes in the mica, h, h', which are designed to let two or three turns be taken back and forth, the fuse, of course, being insulated with a cotton or silk covering, and provides a greater safety factor by having about six or eight inches of length instead of three. Or, if lead fuse wire is used, it may be wound around the outside of the mica two or three times to obtain the same result.

Fig. 41 has insulated fuse wire done up in a coil to increase the length and also to furnish a spot not surrounded by free air so that the fuse will go quicker.

Both the above forms are very convenient in testing, as the clip has only to be pulled out to open the line. Another form which has found favor in many places, especially with the underwriters, consists of a spring strip held down by the fuse wire. As long as the fuse is in good condition the strip will stay down, but should it become opened the spring flies up, throwing the two ends far apart, thus preventing the arc which often follows the

destruction of a fuse. Even if highly heated, the tension on the spring will break the fuse and cut it out anyhow.

But forms, Figs. 40 and 41, are almost as free from arcing and just as reliable on account of their greater length of fuse wire, and when mounted on porcelain blocks an arc, on a half ampere fuse, cannot be very dangerous.

In order to protect the switchboard, the fuses should melt with any current above half an ampere within a reasonable length of time, say, five or six seconds. The easiest way to test this if an ammeter is not handy, is to take a 110 volt lamp, an old one that has burned 600 hours or more, which will pass from .60 to .75 of an ampere; connect the fuse in circuit, and if it doesn't go in five seconds don't use it. If a 110 volt current cannot be had, use one of 50 volts, but with a new lamp, and, as a 50 to 55 volt lamp takes about one ampere of current, the fuse should melt right away in not more than one or two seconds.

In writing to manufacturers of fuse wire, be sure to state the highest limit of the current which it is desired the fuse shall carry, and also the length of fuse used, for a fuse two inches long will carry at least twice as much current as one six inches in length.

Fuses made of lead wire are apt to increase in their heat carrying capacity, and a fuse wire which when new, will blow at half an ampere, may stand one ampere after being in place a few months; on this account some managers insist upon having them shellaced as soon as they are made up, to prevent the action of the air. German silver, aluminum or copper, make the most reliable fuses. In Fig. 42 is shown a form of lightning arrester, combined with a fuse, which explains itself. A pair of carbon blocks, one connected to the ground plate by a spring clip, and the other connected to line the same way, a thin strip of mica holding them apart. The mica has two or three holes punched through the centre, and the air in these holes being nearly all expelled as soon as the discharge takes place, it will in this way offer a path of low resistance to ground as long as the current remains on the line, while the absence of air at these points prevents the carbon from burning up. Carbon does not corrode nor fuse, and as long as it lasts it is always ready for business. There are several forms of lightning arresters made on this principle, and they constitute the most efficient class I know of.

As to the necessity for fuses and lightning arresters in cable boxes, practice differs greatly. In some parts of the United States, as on the Pacific coast, lightning arresters are not considered necessary, and the only safeguard is a fuse placed behind the switchboard to protect it against trolley or electric light currents, while in some of the Southern States too many safeguards cannot be used, and even then lightning will sometimes go by them all.

When lightning gets into the cable over a single conductor, the static and inductive resistance of the cable sheath, and the other conductors, especially the one it is paired with, makes a condition that is very liable to break down the insulation between them. If, however, lightning arresters are placed in the terminal box, it will either flash to ground or become so divided among the various conductors as to be practically harmless. Even where there are no arresters it will generally spread more or less over all the terminal binding posts.

It is, I think, an open question whether fuses are much of a protection against lightning, for when it has come several feet through the air for the express purpose of visiting an exchange, it will not be stopped by two or three inches of fuse, and before the fuse can possibly cut out the lightning has gone by and the line has been opened without being afforded any protection.

On the whole I think that the best place for fuses is behind the board or in the cross connecting room, where they can be readily inspected and replaced, and if the insulation of the cable is up to standard the only effect of a trolley current will be to blow the fuse and make the cable noisy, till some one can go out and remove the cause of the trouble. But where lightning is to be feared I would put lightning arresters in the cable box, but without the fuse, for it will have to come fast and furious if the static induction of the cable will not shunt it to the ground strip, but to make sure it would be well to use these arresters in the exchange also. Where a metallic circuit, or common return system is used, it is a good idea to connect the middle or ground post of the subscriber's instrument, to ground the toothed plates generally affording sufficient protection.

In some cities where Underwriters' rules are strictly enforced, the company may be compelled to place a fuse block where the wires enter the subscriber's premises. In that case use a 1 ampere fuse, for one doesn't want a fuse to give way for every little thing that comes along. The inspector may also require porcelain or glass tubes where the wires enter the building.

In concluding I can lay down a few general rules which will produce the most satisfactory results, though they are not to be taken as conclusive.

1. Place lightning arresters with ground strip both in the cable box and in the exchange. If the return wire is grounded or connected to the lead sheath of the cable, connect the ground strip to it by a wire not smaller than No. 10 B. & S. G., or if the common return is not grounded, connect the ground strip of the arrester by a No. 6 wire to ground at the foot of the pole. It does not matter so far as lightning is concerned whether this ground wire is iron or copper, for Dr. Lodge's experiments would seem to show that possibly iron or steel is even better than copper.

2. If the cable boxes are easily reached and inspected from the exchange, place fuses there; if not, place them behind the cross connecting board. Too many fuses in a circuit are a source of annoyance, and it is better to have a drop burned out occasionally than to have a constantly interrupted service.

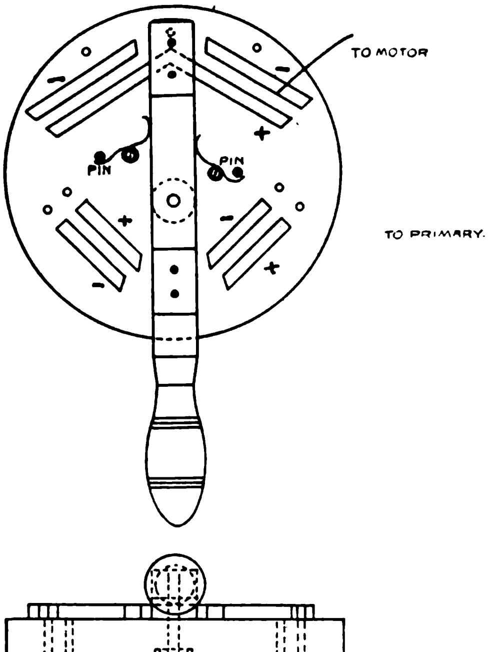
3. If the common return is not grounded, a large lightning arrester something like the Wurts non-arcing arrester, made by the Westinghouse Elec. Co., or the street railway arresters made by the General Electric Co., will be found best adapted to this work. As an additional precaution in this case, it would be well to have a switch connected to a ground wire, so that in a thuuderstorm the ground could be thrown in.

ROENTGEN RAYS

A New X-Ray Switch.

BY F. S. KOLLE, M. D.

IN The Electrical Engineer of Dec. 9, 1897, appeared a description of a double current switch for X-ray work devised by me for the purpose of controlling the currents of the motor make and break arrangement and the primary to the coil; but owing to the fact that the current going to the primary could not be reversed without practically making a duplicate of itself, to serve in that way, and owing to the statement



THE KOLLE X-RAY SWITCH.

of Mr. E. Willyoung in The Engineer of Dec. 30, 1897, in which he says, "There is danger of closing both circuits too nearly together," I devised the following new contact switch to over-

come all difficulties. The diagram herewith reproduced was completed January 12, 1898, but owing to the many demands made upon me in medico-surgical radiography, I have failed to write up the matter.

The switch is both simple and economic, being much cheaper than my former "jack-knife" device, and only on account of its great simplicity of construction do I deem it of sufficient merit to dwell upon it at all.

The base and handle are made of fibre, the clips of brass or copper, and the contact metal of brass sheeting. A spring washer guarantees sufficient pressure in making current; a metal or hard rubber cover would be a valuable addition. The handle is so placed, eccentrically, that the current of the motor can, and is, first thrown in. A small pin, placed, as shown, stops the handle from being crowded over too far. A German silver wire spring is so fixed on either side of handle bar as to produce sufficient counterforce to prevent closing both circuits too suddenly; but this is obvious when the operator is sensible enough to know the difference between handling a switch and a crow bar. However, to overcome objections it may be employed. By throwing the handle from side to side, the current to the primary is reversed at will.

Current Transformers.—II.

BY CHARLES T. CHILD

THE rotary converter, rotary transformer, or "rotary," as it is variously called, is a machine in all respects similar to a direct current dynamo, except that its armature winding is tapped at appropriate equidistant points and connected to collector rings. Alternating currents of the proper phase relation and frequency supplied to these drive the armature as a motor, direct currents being taken off by the commutator brushes exactly as if the machine were driven by an external source of power. But the current thus obtained cannot be regarded as generated in the armature. If the armature is driven at the speed at which it runs as a synchronous motor by an outside power, alternating currents, similar in phase and frequency to those supplying it, will be generated in it and rectified by the commutator. When the machine is supplied with such currents from an external source a small portion of the energy is utilized in turning the armature while the greater part of it is rectified at the commutator and flows out into the circuit as direct current.

The reactions taking place in the armature of a rotary transformer are of considerable complexity. By proper manipulation of the field strength the power factor may be made unity, or the machine may impress leading or lagging currents on the line like any other synchronous motor. The direct current voltage is dependent upon that of the alternating current and hence, in most cases, it is necessary to use stationary transformers to reduce the alternating line voltage to a proper value for the supply of a given direct voltage. Varying the field strength does not produce a corresponding variation of the voltage of the direct current side of the machine, but introduces modifications of the phase relations between current and e. m. f. in the alternating circuit which may be very troublesome. Generally speaking, the field strength must be governed by considerations of the alternating current supply line for the best results.

The allowable output of a rotary transformer is dependent not only upon its size, but as well upon the character of the supply current, whether this is single-phase, three-phase, quarter-phase, etc. It may be shown that the ratio of the C^2R losses in a given rotary to those that would be experienced if the machine were driven at the same output as a direct current dynamo is:

$$\frac{8}{n^2 \sin^2 \frac{\pi}{n}} + 1 - \frac{16}{\pi^2} + \frac{4}{n} \tan^2 \beta$$

where n is the number of equidistant points in the armature winding connected to the collector rings (in a bi-polar machine) or simply the number of rings, and β the angular value of the phase displacement between current and e. m. f. on the alternating side. Assuming the phase displacement to be zero, this gives as the "rating" of rotaries in terms of their performance as direct current dynamos the following figures[2]:

Single-phase.	Three-phase.	(Two-phase.) (Quarter-phase.)	Six-phase.
0.85	1.34	1.64	1.96

From this it is at once evident that the quarter-phase rotary for a given output may be made smaller than the three-phase machine and much smaller than the single-phase machine. Indeed the single-phase rotary, unless the current and e. m. f. on the alternating side are kept very closely in step with each other, is very inefficient and wastes much energy in heating loss.

The efficiency of a polyphase rotary is very high, higher indeed than that of the corresponding direct current dynamo, but this figure is deceptive since, on account of the interdependence of the currents and voltages on its two sides, stationary transformers are always needed in transmission work and the losses in these should be figured in addition to those in the rotary.

Since any variation in the voltage of the alternating current supply is immediately manifest at the direct side of the machine it is not so useful for work requiring close regulation as the motor-dynamo described above, but finds its principal field of usefulness in railway and electrolytic work. In it, as in the double-winding machine, the question of frequency enters and, in large sizes, considerations of speed, etc., practically limit this to 30 or 40 cycles per second. The high efficiency and complete reversibility of these machines make them peculiarly applicable for steadying the voltage of a polyphase system of supply when used in connection with a storage battery. In this way an alternating current system may partake of the hitherto distinguishing advantage of a direct current system, a steadying arrangement of this sort having been recently installed in one of the finest lighting central station systems in the world[3].

As compared with the motor-dynamo combination the rotary transformer possesses the great advantages of high efficiency, cheapness and simplicity. It is also self-starting on the alternating side, running up to synchronism without difficulty. Its disadvantages are the interdependence of the alternating and direct current voltages and the very limited range of adjustment of the latter. These, however, are by no means serious in railway work or in heavy electrolytic work, and in these directions the rotary has proved itself invaluable.

A type of this machine, miscalled the "induction rotary," has been used to a limited extent, the peculiarity of the machine being that it is not provided with field windings, the field magnetization being due to armature reaction from the lagging current. As the heating effect of lagging currents increases with the square of the tangent of the angle of lag it is evident that such machines cannot be as efficient as those in which the power factor can be maintained at unity, nor can they be of as large output per unit of weight. In addition to these defects, this type sacrifices the valuable control of the phase relations of the alternating system inherent in the usual form.

It is evident from an inspection of the table and formula given above that the output of a given machine will increase or, what is the same thing, that the heating loss will decrease and the efficiency improve as the number of collector rings or number of phases of the supplying current becomes greater. The very interesting transformer of MM. Hutin and Leblanc takes advantage of this fact and, while its mechanical complexity is very great and has limited its use, this type of rotary possesses none the less great electrical interest.

If, in a single-phase stationary transformer of which the primary coil is carrying an alternating current, the number of turns of the secondary connected to a given circuit can be varied synchronously with the current and according to a sine law, the potential at the terminals of the circuit may be kept constant and a direct current will flow in it. It is upon this principle that the "panchahuteur" works. It consists of a polyphase transformer of which the secondaries are divided into equal numbers of equal coils, these being grouped together and connected to brushes bearing upon an equal number of collector rings on the rotating shaft of the machine. This shaft also car-

[2]Woodbridge and Child, The Electrical World, Jan. 1 and Feb. 12, 1898. C. P. Steinmetz, Elektrotechnische Zeitschrift, March 3 and 10, 1898.

[3]See "The Edison Electric Illuminating Co., of Brooklyn," by Jos. Wetzler, The Electrical Engineer, January 6, 1898.

ries an armature and its commutator, the number of segements in the commutator being the same as the number of collector rings and one ring being connected to each segment. The armature turns in a proper field as a synchronous motor, and the currents from the secondaries flowing through the rings to the commutator are taken off by brushes as direct current. The machine is thus a rotary converter in which currents of many phases are transformed, the rotating armature of the usual type being replaced in part by the divided secondaries, which properly distribute the currents, and in part by the small motor armature, which gives the necessary rotation. The efficiency of the machine is very high and its output for size and weight remarkably large.

For phase transformations a number of more or less simple methods are in use. If an iron ring is wound with a continuous coil tapped at four equidistant points and these points connected to a quarter-phase circuit, then a three-phase current may be withdrawn from three equidistant points and, in general, n-phase currents may be taken from n equidistant points. This apparatus is perfectly reversible, the essential feature being the establishment of a rotating polarization of the ring. The Scott system for transforming between quarter-phase and three-phase currents (which is installed as a part of the Niagara transmission referred to above) uses two stationary transformers, of which the terminal of the secondary of one is connected to the middle of the secondary of the other. By properly proportioning the windings of the two secondaries a three-phase current may be withdrawn from the three free ends of the secondaries when the primaries are connected to a quarter-phase source.

A great desideratum has been to obtain a simple means for deriving polyphase currents from a single-phase source of supply. It was an early suggestion to pass a single-phase current through a divided circuit, of which the inductance of the two branches differed widely, thus causing a lagging of phase in the more inductive branch. An improvement upon this method consists in the use of a condenser in the path of less inductance giving rise to a leading phase and further separating the elements of current. These methods work well with small currents, but considerations of cost and the incident waste of energy prohibit their use for large powers.

The phase separating system of Ferraris and Arno, for deriving polyphase from single-phase currents, is very ingenious. It consists of two coils mounted as in the stator of a polyphase induction motor, one of them being the primary and connected to the single-phase circuit. A short-circuited rotor completes the apparatus. When this is running as a single-phase induction motor a single-phase current, displaced in phase from that in the primary by an amount equal to the angular separation of the two coils, will flow in the second coil, and the combination of this with the original single-phase current gives three-phase or quarter-phase current, according to the position of the second coil.

From the descriptions of the various methods of current transformation it is evident that each has its particular field of usefulness and that none can be selected as the best unless all the conditions of its service are known. For arc lighting the simple rectifier seems well suited, not only on account of the efficiency of the apparatus, but as well because of its simplicity and small size. A rectifier, however, requires as much attention as a dynamo, and in a recent fine installation three-phase synchronous motors are used coupled to ordinary direct current arc machines in preference to them. For heavy work, such as electrolysis and electric traction, where the conditions do not require close regulation of voltage, the rotary transformer is pre-eminent, as it is also in regulation work in connection with a storage battery. Where the alternating current is single-phase or where the requirements necessitate accurate regulation or a variable voltage at the direct current side, the motor-dynamo combination seems best fitted for the work. The interesting machine of Hutin and Leblanc appears also to have qualities that make it well worth further development and simplification.

THE RAILWAY TELEGRAPH SUPERINTENDENTS are to meet in Omaha on June 15.

MR. C. J. GLIDDEN has now become president of the Erie Telephone and Telegraph Co., with which he has so long and brilliantly been connected.

ELECTRIC TRANSPORTATION

The Selection of Proper Speed for Railway Motor Equipments.

BY J. R. CRAVATH.

THE equipment of an electric road is a series of selections from start to finish, selection of material, selection of types of apparatus, and selection of the practice to be adopted in operation. Among the many questions that are apt to be lost sight of when purchasing motors for an electric road is that of the proper speed of motors, and by this I mean the maximum speed at which the motors will run, as well as the schedule speed for which they are intended. It is very often the case that in selecting high speed motors the purchasers are acting on the adage that speed is a good thing, therefore "while your a gittin' git a plenty." The result of this policy has been to handicap numerous roads with motors which are much too fast for the service, resulting in excessive repairs and an unnecessary consumption of power. It may sound strange, but it is true that one set of motors may take twice the current and heat twice as badly in maintaining a given schedule as another set of motors geared lower but of the same dimensions otherwise. This of course is a rather extreme case, but it is not far from some conditions which exist in actual practice to-day. The reason for this may be more apparent after thoroughly understanding the following principles:

1. To produce a given torque or acceleration, the current required varies directly according to the maximum speed for which a motor equipment is geared.

2. The heating of a motor (C^2R) producing a given torque or acceleration varies directly as the maximum speed for which a motor is geared.

When it is remembered that in nearly all classes of electric railway service the principal work done by the motors is acceleration, it will be seen how important it is to select a motor of a speed which will give a high torque per ampere of current. These principles applied in practice mean that it will take twice as much energy to get a car up to a speed of 20 miles an hour if equipped with motors geared to 40 miles an hour, as it will to get the same car up to 20 miles an hour if it is equipped with 20 mile an hour motors, the rate of acceleration being the same in both cases. Furthermore, the 40 mile motors will heat twice as much as the 20 mile equipments during the process. Of course the higher speed equipments can be made to maintain a much faster schedule than the slower provided there is enough traction on the rails to permit of a faster acceleration or provided there is distance enough between stations to admit of a higher maximum speed than the 20 miles an hour being attained. But this does not alter the fact that in some cases high speed motors are selected they will be of ample size to correspond formed with slower speed motors at much less expense for power and repairs. When these principles are more generally understood there will not be such a cry as there has been for several years past for high speed motors, and when high speed motors are selected they will be of ample size to correspond with the increased horse power taken by the faster speed.

Connecticut Trolley Notes.

The People's Tramway Co., chartered in 1895, has been organized at Danielson, Conn., by the election of the following officers: President, F. A. Jacobs, Danielson; Secretary, R. L. Warner, Boston; Treasurer, V. W. Rossiter, New York; Directors, F. A. Jacobs, O. W. Bowen, Danielson; A. B. Sprague, Plainville; W. P. Kelley, Dayville; R. L. Warner, Boston; V. W. Rossiter, New York.

Application has been made to the town of Plainville, Conn., by the management of the suburban trolley line, now extending from Hartford to Unionville, for an extension to Plainville, a distance of four miles. The town is now reached by trolley from New Britain. The proposed layout of the extension connects Unionville with New Britain, forming a loop that will afford residents of Hartford facilities for pleasure rides to New Britain and Plainville, then to Farmington and back to Hartford by the way of West Hartford.

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The Paris Exposition of 1900.

IN view of the reported ill will toward this country manifested recently in France, it is not surprising that there should be a strong feeling here on the subject, and that it should imperil the proposed appropriation for the Paris Exposition of 1900. It would be a great pity if such a sentiment prevailed. France may not apparently be living up to her great traditions of liberty just now. Her notions of internal justice may outrage American ideas of the proper administration of law; and as to external policy, we may marvel at seeing the "grand nation" satisfied to serve as a mere Cossack outpost. As for our quarrel with Spain, if ever there was a war begun on sentimental impulses that might appeal to a generous people like the French, it is the one we are waging for the tortured Island of Cuba; but they do not yet see it with our eyes. Still all this is no reason why we should be as narrow in our actions as the lighter, less responsible element in France appears to be. We are rejoicing deeply at this moment in our new ties of friendship with England, and we do not allow the foolish talk of some snarling irresponsible chatterers to disturb it. In the same manner, we should try to convince our French friends that we wish them well and that we do not take the sneers of boulevardiers or threats of stockbrokers as representative of the true feelings of enlightened France.

He who would have friends must show himself friendly, and now is a time for this country to make itself friends among the nations of the earth in every honorable way. If we can afford to spend $1,000,000 per day in the cause of freedom, we can well afford to spend $1,000,000 in two years in such a cause of intellectual and industrial advancement as the Paris Exposition represents. Yet the proposed appropriation was only $750,000 and there is now talk of cutting it down to $500,000. Such parsimony is wrong. At the present moment we are anxious to push export trade all we can, and Paris in 1900 will be a centre to which buyers will flock from all parts of the world. To them not less than to Frenchmen our appeals and arguments in the shape of our products will be addressed, and the appropriation is as much for them and our salesmen abroad as for Paris.

To put the matter in vulgar parlance, do not let us "cut off our nose to spite our face." At this crisis of national development, we must go before the world not simply with the record of victory over a decrepit power by sheer force and weight of arms, but as seeking those other victories of peace in which alone the permanent welfare of our people must ever rest.

The Development of the Central Station.

THERE are few men who have stood closer to Mr. Edison in the practical development of his lighting work than Mr. Samuel Insull. No one has had a better opportunity of watching the growth of the electrical industry and of learning the lessons which the changes of that growth produced. Hence though entering upon central station management somewhat late in his career, that gentleman is for that very reason peculiarly fitted to pronounce upon the problems presented in central station development from the standpoint particularly of the financier. It is a matter for congratulation, therefore, that Mr. Insull has broken a long silence and given his opinions on some points of vital importance in central station management as embodied in the address delivered before the students of Purdue University. Passing over the purely historical part of Mr. Insull's address, it is evident that he is more firmly than ever convinced of the superiority of the low tension system of distribution as distinguished from the house-to-house converter system. In this contention he is well supported by general experience, and though he does not decry the alternating system, he emphasized the fact, recognized some time ago, that the block converter must supplant the house converter.

Mr. Insull goes into considerable detail in connection with his own station in Chicago, claiming for it the most economical production of current of any such or similar sized stations in the country. In this he will probably not be disputed, situated as he is so fortunately to secure cheap fuel, having at his right hand an excellent corps of engineers and at his left a board of directors who are willing to spend money with a view to the future as well as the present.

But of all the points dwelt on by Mr. Insull, none is of greater moment than his discussion of the cost of product as related to the interest on investment. As Mr. Insull shows, it is quite possible that the station manager may spend so much capital as to eat up many times over in interest charge the saving that he makes in direct operating expenses. Operating cost and interest charge should therefore never be separated. This central station maxim is particularly to be kept in mind in connection with the use of storage batteries. It took Mr. Insull a long time to make up his mind to install the storage battery about going into operation in his Chicago station, but for that very reason he may be considered to be all the firmer in his belief as to the value of that type of station auxiliary. Knowing as we do, that Mr. Insull has given this subject deep thought, it is interesting to learn the results of his study of it. These may be said to be embodied in his statement that it would appear to be economical to use storage batteries in connection with central station systems, the peak of whose load does not

exceed from two to two and one-half hours. As it is safe to say that the vast majority of central station load peaks come within these limits, Mr. Insull's dictum is equivalent to the statement that as a general thing the storage battery will prove a factor of economy in central station work. If Mr. Insull had embodied nothing else in his paper, that one statement in itself would have been a sufficient raison d'être for his address. There are other financial and economic truths scattered throughout this valuable contribution to central station literature which we recommend to the earnest study of all who are interested in making central stations profitable investments.

Some Lessons Taught by the Electrical Exhibition.

THE second electrical and kindred industries exhibition, held in Madison Square Garden, New York, during the month of May, under the auspices of the New York Electrical Society, will in a few days draw to a happy close and leave behind in the minds of thousands memories of a work well done. That the exhibition was a success, no one who has had the good fortune to visit it or has read the accounts of it in the electrical press, will deny, and this in spite of the war and a rainy month of May the like of which cannot be found in the official records. The influence exerted by the exhibition and the lessons which it has taught are too manifold to be enumerated here, but we may point out the far reaching effects of it from the commercial, educational and social standpoints. Taking up first of all the commercial influence of the exhibition, we must emphasize once again the absolute necessity of united effort, good feeling and fair and open competition in order to build up and advance an industry. The fact that firms represented at an exhibition send thereto their best and latest products and see those of their competitors is an inspiration for better effort as well as a valuable bit of information which a wide awake and progressive concern will employ to good advantage. Aside, however, from this tendency to educate manufacturers by placing them in a competitive sphere, the benefits to be derived from exhibiting products are more direct and remunerative in the way of sales made on the spot or later on to persons who have had an opportunity to inspect the apparatus of the various exhibitors. This brings us to the second and equally important function which an electrical exhibition has to perform, namely the educational one. Not only to educate one another, broadly, as an offset to the tendency towards specialization, but to educate the man with theory minus practice, the student and the general public. This is indeed a heavy task, and some may think a thankless one, but the crowds who have daily and nightly visited the exhibition and have expressed high appreciation of the many admirable features which had been arranged, hardly warrant such a belief. Each machine or device, each application shown within and without the Garden has its story to tell, its lesson to impart. And while all these productions were an education by themselves, there were arranged a number of features most of which were strictly educational, while some have already attained commercial importance. No one who has seen the beautiful and inspiring Moore Chapel will ever forget the impression which this novel departure of interior illumination made on him. Add to these numerous features the wax tableaux and the series of popular lectures on electricity by prominent men, and no one will question the phenomenal educational influence exerted by the exhibition.

And now a few words about its social influence on the entire electrical profession. It has cemented many ties of friendship between those engaged in electrical pursuits, which cannot help but bring about beneficial results. As one speaker so fitly said at the dinner of the New York Electrical Society: "We must broaden in our endeavors and carefully guard the interests which are entrusted to us. We must not undervalue ourselves, for in proportion to the value which we place on ourselves, will the outside public regard our worth."

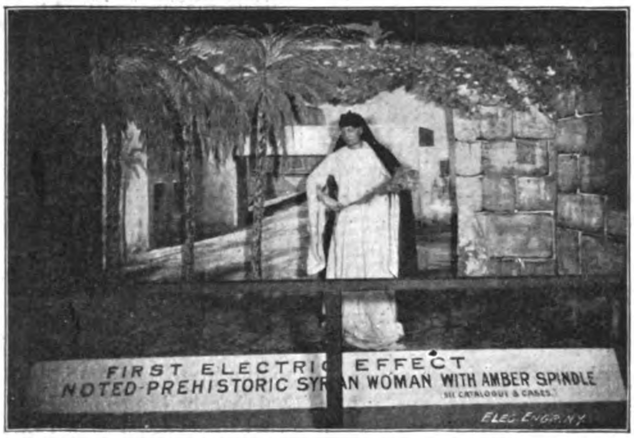
The New York Electrical Society.

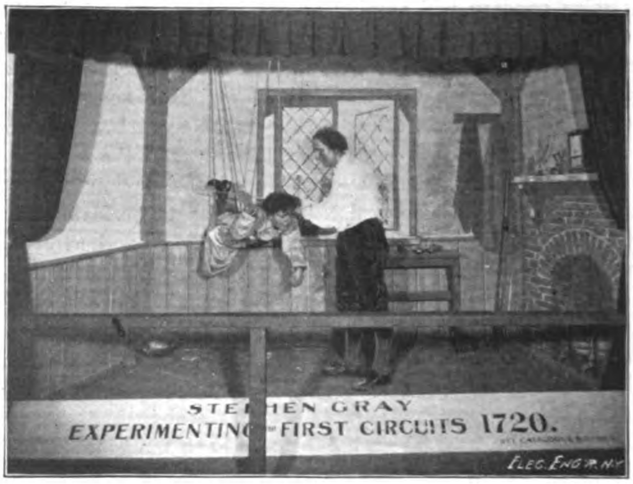
THE annual dinner of the New York Electrical Society served to bring out a representative body of men and demonstrated that both in years and in influence this society stands well in the lead of local electrical bodies in this country. Its work in connection with the present Electrical Exhibition has resulted in a large increase in membership and in increasing its scope of usefulness. The gathering was presided over by the newly elected president, Mr. Gano S. Dunn, and was addressed by a number of speakers who dwelt earnestly and effectively upon various topics of electrical interest. Among them was one which has of late cropped up on several occasions and on which it is well to have some light thrown. Replying to the toast "The Technical Colleges," one of the speakers remarked that the work of our institutions of learning had already left its impress on the art and industry, short as the time had been in which those influences had been at work. But encouraging as the past had been for the electrical engineering graduate there was beginning to be heard the cry that the colleges were turning out too many electrical engineers. Based on an investigation he had made the speaker stated that there was no good foundation for such an apprehension. He pointed out the fact that a great many young men were pushing into the electrical courses of our colleges who ought to have studied law, or divinity, or become professional baseball players, or gone directly into mercantile life. For such there could never be any hope. These men necessarily become itinerants, and the profession could well get along without them. But was it conceivable that our great and enterprising country was incapable of absorbing annually a few hundred trained men in an industry whose expansion has seen no let-up even in the dullest times, and whose ultimate place in the world's economy was written so large that he who runs might read? The speaker insisted that we could not have too many trained men in the electrical field; we were indeed to-day still suffering from the lack of such ten years ago and would continue to suffer for some time to come. It was not necessary that everyone of these electrical engineering graduates should make it his object in life to become the technical head of a factory designing electrical apparatus of all kinds, from a push-button to an induction motor. A couple of dozen such men, it was believed, were sufficient to supply the needs of the whole country. But there were hundreds and thousands of situations in our central stations, large isolated plants, in our engineering establishments, and in our long distance transmission plants where electrical intelligence and training were now recognized as a sine qua non. These were the places which should be sought for, and our colleges are the honored cradles of the new force of men whose value is but now beginning to be felt. The day of the so-called practical man in electrical engineering was fast disappearing. The speaker urged that the colleges go on with their good work and believed that when the wail "overcrowded" was heard it was the voice of an unfortunate who had missed his calling. The lesson which the speaker evidently desired to bring home to his auditors was that electrical engineering will for a long time to come occupy a promising field for young engineers, but that in this, as well as in every other profession, only those can hope to succeed who have at least a fair amount of natural aptitude for the work and a proper training therein.

The Historical Wax Tableaux at the Electrical Exhibition.

THIS is an educational age and the effort to impart information takes many forms. For the great mass of the public, it is certain that the instruction must be conveyed in a very attractive manner if it is to be useful; and if this instruction can be given entirely the character of amusement it seems to achieve its fullest success. At the Electrical Exhibition this idea has been worked out in various ways, but perhaps in no instance is the result happier than it is in the Historical Wax Tableaux, placed in eight large alcoves around the Concert Hall. The location of these groups is in many respects ideal, the niches are of just the right size, there is space in between them for cases containing literature that illustrates or explains, and as in a picture gallery people can also sit down quietly and study the subject should they wish to do so. The popularity of the Wax Tableaux has been emphatic since the very start. In the afternoon, when little of the machinery is running and when few of the lights in the main hall are turned on, the Tableaux constitute a considerable item in the list of attractions, especially for the throngs of younger folk. In the evening, the groups and cases are densely surrounded, and the real genuine interest taken is shown by the manner in which people read every line, discuss the subject, and often give intelligent explanations to each other, showing how thoroughly well they have grapsed the underlying idea of the evolution that is set forth. It is said that such a systematic attempt to teach history in a science or art has not been made before, and the success may well lead to other attempts in similar directions.

The groups were selected, as to subject, etc., by Dr. Park Benjamin, Prof. F. B. Crocker and Mr. T. C. Martin. They were carried out by the Eden Musee Company, of New York, who, as might have been expected, have done a clever piece of work very neatly. The groups are enclosed by dark drapery and railed in front, from case to case of books, so as to present a continuous line. Banks of colored lamps are sprung into the tops of the alcoves on molding strips, and other lamps are disposed to secure the best lighting effects, which were carefully elaborated by Mr. Max Osterberg and Mr. Lardner, of J. G. White Co. The Concert Hall is decorated in white tints, so that the groups are thrown up in high, artistic relief, producing a most beautiful effect.



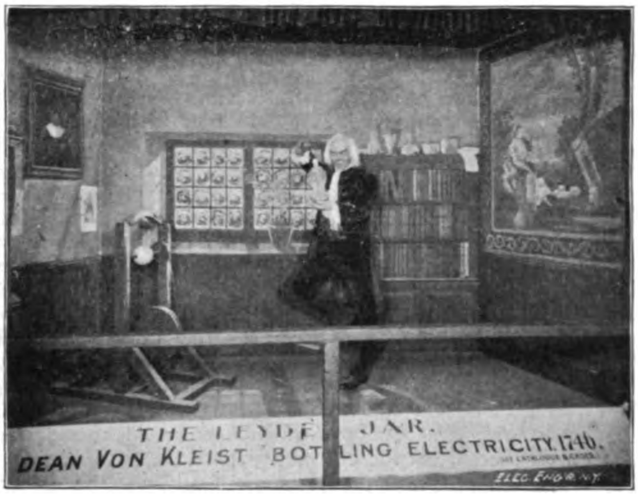


As to the Tableaux themselves and their themes, we cannot do better than reproduce the brief "keys" to them furnished by the Official Catalogue, as follows:

1. The First Recognition of an Electric Effect.—A Syrian woman centuries before our era wonderingly perceives light objects fly to her amber spindle. Prehistoric.—The first discovery of an electrical effect is commonly ascribed to Thales of Miletus, who lived about 600 B. C. But the Syrian women span thread and made cloth long before Thales lived, and for ages they called their amber spindle the "Harpaga" or "Clutcher." This because when it swiftly revolved as it hung on its thread it rubbed against the wearer's dress, and thus becoming electrified it attracted or clutched to itself loose leaves, chaff, and other light objects.

2. The Mariner's Compass. (11th and 12th Century.)—The invention of the Mariner's Compass is sometimes erroneously

ascribed to the ancient Chinese and sometimes to the Italians of the 14th century. It was probably first used at sea by the "wonder-working Finns," in the 11th century, and its invention goes back to the prehistoric dwellers in the valley of the Oxus, from whom knowledge of it spread northward and eastward. The first compass was a needle of iron rubbed with the loadstone and placed in a little bowl which floated in a vessel of water. It served merely to indicate the position of the Pole Star when the sky was overcast. It did not indicate the ship's course as it does now. The old Norse sailors guarded both loadstone and needle with great jealousy, knowing that the safety of the vessel depended on the accuracy of the instrument. But pirates, shipped aboard sometimes as honest seamen and waiting their opportunity, falsified the needle by rubbing it wrongly so as to lead the vessel to wreck and plunder. For this the savage punishment represented was imposed by the Laws of Westby, a sea code of great antiquity. The culprit had a knife thrust through his hand into the mast, and there he was compelled to remain without food or drink until he tore himself free in such way as to leave at least half of his hand behind.



3. The Earth a Great Magnet.—William Gilbert Explaining the Terrella to Queen Elizabeth, A. D. 1600.—Dr. William Gilbert, the father of electricity, was born in 1504, and died in 1603. He was the first to discover the fundamental facts of electricity by purely inductive reasoning—in advance of Bacon, and he gave the science its name. He was Court Physician to Queen Elizabeth, of England. He made many of his magnetic experiments on a globular magnet representing the earth in miniature and hence called a Terrella. This he is represented as explaining to the Queen.

4. The First Conductors or Circuits.—Stephen Gray Experimenting on the Conduction of Electricity, A. D. 1720.—Stephen Gray was a Charterhouse pensioner in London, England. He discovered that the electric current would traverse cord for long distances and pass over a great variety of bodies. He also discovered that it could be kept on those cords provided they were "insulated" by suitable materials, such as silk. His experiments were made with the most homely materials—bricks, stones, coffeepots, canes, fishing rods, etc.—and some of the most striking of them, showing the passing of the current through the human body, were made as here represented on the lads of the Blue Coat School and Charterhouse School, who took much delight in helping him.

5. The Leyden Jar.—The Bottling of Electricity and the Terrible Shock of Dean Von Kleist, A. D. 1746.—Up to the middle of the last century no one believed that electricity could be confined, and that it would escape as fast as generated. Dean Von Kleist, Canon of the Cathedral in Cumin, in Pomerania, Germany, directed the discharge of his electric machine upon a nail which entered a glass bottle of water, hoping thus to entangle the electricity somehow in the water. The experiment seemed to be a failure; so, holding the bottle in one hand, he essayed to draw out the nail with the other. To his intense astonishment, and although the bottle was entirely disconnected from the machine, he received a violent shock. This resulted in the discovery of the Leyden jar, or electrical condenser. When Von Kleist touched the nail, he completed the first artificially made electrical circuit.

6. Identity of Lightning and Electricity.—Franklin Drawing Down the Lightning from the Skies, A. D. 1752.—The great question was whether the lightning in the heavens was the same as the spark made by the electric machine. The French philosophers put up iron rods ninety feet in the air or so in height and during thunder storms drew sparks from them. Franklin held that this did not prove anything, because the iron rods did not go to the clouds. Hence he made a kite out of a silk handkerchief, with two cross sticks and a bit of projecting steel wire, and sent it up from the Commons, near Philadelphia, during a violent thunder storm. He insulated the hemp

kite string from his body by a piece of black silk ribbon, and as a terminal fastened a metal key to the string. When the storm was at its height and the kite buried in the clouds, he touched his knuckle to the key and obtained electric sparks, with which he afterwards charged Leyden jars in the ordinary way. The act was one of astonishing audacity and bravery, for all existing knowledge went to show that it would certainly result in his death.

7. The Beginnings of the Modern Primary Battery or Voltaic Cell.—Galvani's Famous Frog Experiment. (Date Uncertain. Galvani's Essay appeared in 1791.)—A classic, accidental experiment of no particular importance in itself but famous all over the world and commonly adduced as the beginning of the production of electricity in the Voltaic cell. In fact, it marked the beginning of the long controversy between Galvani and Volta, and the outcome of that was the invention of the cell by Volta. The story of it is here represented. Galvani was making some experiments before friends or students in his laboratory. Mrs. Galvani was skinning frogs' legs for soup. One of the company accidentally touched the legs with a knife, when they violently contracted. Mrs. Galvani noticed that this happened coincidentally with the production of a spark from the electrical machine. Galvani tested the matter and proved such to be the case, and in a short time the world had the galvanic or voltaic cell which converts chemical action into electricity by means of two unlike metals moistened or dipped into a liquid.

8. The Beginnings of Modern Dynamo-Electric Machinery.—Faraday's Famous Experiments, A. D. 1831.—Michael Faraday, one of the greatest philosophers the world has ever seen,—a self-made genius—did much of his work at the Royal Institution, London, England, and in his lecture hall made many famous and immortal demonstrations. This is one of them. He is shown standing at his lecture table, which is still there. It having been proved that by means of the electric current, a body of iron could be converted into a magnet, Faraday wound a coil of wire around a piece of soft iron. The wire being insulated by calico and tied by string, on moving this bar and coil before a magnet, he was able to produce a spark at the gap in the coil of wire. From this little experiment, of producing electricity by magnets, sprang all the vast modern development in dynamo electric machinery, and all the art thereon depending, in light, heat, traction, power, etc.

It will be seen that the series closes at a natural point and just where the industrial part of the Exhibition takes up the story. The groups have evidently been studied out with great care, not with the idea that they might be exactly correct in every microscopic detail of archæological data, but in the broad, helpful sense and with the object of assisting study and memory in a graphic way. The Gilbert group, for example, assumes that Queen Elizabeth in one of her progresses through Essex has naturally called on her own court physician at his quaint house in Chelmsford to see with womanly curiosity what he is really driving at, and the interior is roughly drawn after one of the pictures of a laboratory in his own "De Magnete." In the Faraday Tableaux, several portraits were studied, the Royal Institution background is drawn from a photograph of the lecture hall, and on the table are instruments of the very time loaned by Dr. R. Ogden Doremus. In the adjoining case is one of Faraday's own little experimental magnets loaned by Mr. C. O. Baker, Jr., the president of the Exhibition. Whatever the inevitable shortcomings of such an effort to create living pictures out of the past, there can be no question as to the many meritorious features of this attempt and certainly none as to its immense popularity with visitors to the Exhibition, technical and lay alike. We shall not be surprised to see the example thus set followed and imitated.

MANAGER McDONALD, of the local telephone exchange, has taken the position of general manager of the new concern, the Augusta, Ga., Electric and Construction Co., which will do a general electrical business at 212 McIntosh street. He will have associated with him Mr. B. R. Mitchell as superintendent of construction.

NO ELECTRICITY IN TURKEY.—The Sultan has, it is alleged, now prohibited the use of electricity in Turkey for any purpose, and patents for electrical inventions are consequently refused.

Running Notes on the Electrical Exhibition.

Edison at the Show.

Despite the phenomenal and unparalleled wet weather—attributed popularly to the close relationships existing between this country and England—the attendance during the past week has been very large, and it may, with appropriate use of the term, be said to have rained celebrities. We give here a happy little snapshot of Mr. Edison on one of his visits, caught in the Edison temple and just about to have some "electric shortcake" with two of the Edison Co.'s officials—Messrs. Arthur Williams and J. W. Lieb, Jr.; and it may be noted that many of the distinguished folk "round up" in this way to enjoy the Company's hospitality before going away—a cup of tea or coffee, a hot biscuit, strawberry shortcake or whatever the electric kitchen may have been busy on.

The telephone had its share in the successes of the week, particularly in its long distance work. Three or four of the comic operas playing in the city are brought to the Theatrophone board, but not satisfied with that the New York Telephone Co. introduced on Monday night a concert by the famous Lauder Orchestra then playing in the Palm Garden at Milwaukee, about 1,100 miles away. In spite of the drenching rain, the music came through very satisfactorily to the delight of a large number of auditors. On Wednesday evening Sousa's march, "Unchain the Dogs of War" from "The Bride Elect," was switched through the Theatrophone to the White House in Washington, where Mrs. McKinley and a party of friends enjoyed it immensely. Mr. F. W. Hawley engineered the thing, and Messrs. Webb, Brewster and Dowd carried out the arrangements perfectly. The performance attracted considerable attention on the part of the city newspapers.

An ingenious innovation during the week in the Moore Chapel was the introduction of an Edison phonograph to take the place of a parson. There is already a fine church organ which is played continuously by a good organist, but it was felt that this hardly carried out the ecclesiastical idea to the full. Accordingly Messrs. William Edison and E. M. Smiles loaded a phonograph cylinder with the Lord's Prayer, the Twenty-third Psalm and the Beatitudes. The phonograph has been mounted on the chair at the altar with its brass funnel sticking out over the lectern, and the throngs of people as they walk through are greeted with the familiar sacred passages. The effect on the auditors is remarkable, and the comments suggest that many new possibilities are opened up for poor churches and outlying parishes, especially as many phonograph cylinders now carry hymn words and tunes, and as mechanical organs can obtain an inexhaustible supply of roll music of a religious character. A whole church service run by machinery impends in the near future.

The Exhibition would normally close on Tuesday of this week, but as an offset to the bad weather it has been decided to round out the week by continuing open for the other four days. To this plan practically all the exhibitors have given their cheerful assent.

Exhibit of the Walker Company at Madison Square Garden.

CONSPICUOUSLY located on the main floor and occupying a space of 800 square feet is the very interesting and instructive exhibit of the Walker Company, of Cleveland, Ohio. No attempt has been made to decorate the space elaborately as that might hide some portions of the heavy machinery from view. Open framework surrounds the booth which has a number of entrances open at all times to the interested visitors. Within the space this enterprising company have placed representative apparatus of each department, the most prominent ones being the railway apparatus. There is shown a heavy McGuire truck for double truck cars, equipped with two Walker 20-L motors for elevated or heavy suburban traffic. They are

of the type built for the Metropolitan "L" Road of Chicago. The motors have a capacity of 150 horse power each, and a car equipped with two of these trucks has therefore a capacity of 600 horse power. Regardless of this heavy output, the equipment is no larger in height or wheel base than ordinary standard trucks. The wheels of this truck are raised from the floor and the motors are shown in operation, being controlled by a type S solenoidal blowout controller, the cover of which has been removed. Naturally this has attracted a great deal of attention, as have also the parts of the controller which are exhibited on a platform. There is also shown a standard street railway equipment complete, furnished with No. 4 A. S. motors and a Peckham centre-bearing swing-bolster, maximum traction truck equipped with a 25 horse power motor. The Walker underground conduit system is clearly and effectively shown in the full size conduit section and car, which is in operation on the main floor. The new design Walker pivotal trolley base fitted with pole and Grover head is also shown, and the street railway switchboard with generator and feeder panels has attracted a great deal of attention. These panels are fitted with Weston volt and ammeters, I. T. E. circuit breakers, triple grid field rheostats, Garton lightning arresters, etc.

Besides this railway apparatus, there is shown a 50 kilowatt Walker alternator. The peculiar feature of this machine is that the armature is the stationary and outer member, while the fields revolve and are excited by a single field winding concentric with the shaft. A composite field winding is employed, the series coils being supplied with current by a rectifier. In the generating section in the basement the company have a 50 kilowatt lighting generator direct connected to an Armington & Sims engine, and a 25 kilowatt lighting generator direct connected to a Nash gas engine. The former unit supplies lights to the building and the current is distributed from a handsome isolated switchboard installed by the Walker Company.

They also show their well known enclosed arc lamps for either multiple or series circuits, the mechanism of which consists of a chain fastened to the upper carbon holder, running over a sprocket wheel and being partially counterweighted. A magnetically actuated clutch operates on a pulley coupled to the sprocket wheel.

But the instrument which has attracted the greatest interest is the new integrating direct current ammeter shown in actual operation. It consists of a flat copper disc, upon which are spread out three coils of wire, connected to a long, slim three-part commutator through which the current to be measured is introduced. Permanent magnets react upon these coils and generating a Foucault current in the disc brake, a torque is introduced which is proportional to the current to be measured. The instrument is extremely simple and compact and is claimed to be very accurate. There are very few moving parts, and these, as well as the dials, are all in plain sight of the consumer or attendant.

Besides showing the above numerous products, the company expect to exhibit before the close of the exhibition a number of 20-L motors, such as were recently installed in Chicago and which have already been shipped from the factory at Cleveland. A vast amount of interesting and artistic literature bearing on the manufacture of the Walker apparatus is distributed, and a stand has been erected in one corner of the booth on which are mounted photographs of prominent Walker installations. The company is ably represented by Mr. J. S. Anthony and a corps of assistants.

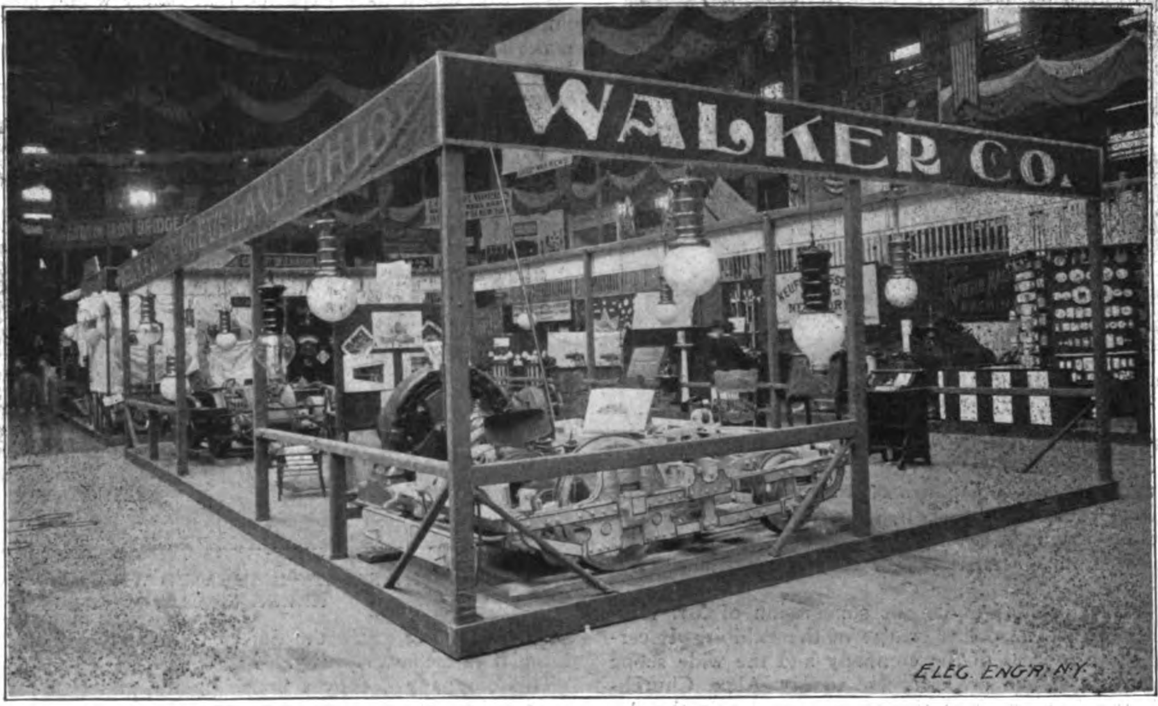


EXHIBIT OF THE WALKER CO., OF CLEVELAND, MAIN FLOOR.

Exhibit of the Excelsior Electric Company, Churchward Apparatus.

ONE of the largest and most striking exhibits on the main floor of the Garden is that of the Excelsior Electric Company, manufacturers of the Churchward apparatus. The exhibit is particularly striking on account of the great variety and originality of the apparatus shown, most of which has never been exhibited before. Among the novelties should be mentioned a single-phase self-starting alternating current motor driving a Blackman fan, showing its ability to start and bring its full load up to speed. This machine is fitted with the company's automatic starting device whereby the current is closed at the main switch. The machine starts and comes up to synchronous speed automatically. This type of machine has been designed especially for elevators, pumps, or ventilator service, where the motor has to be started automatically. Another specialty is the single-phase self-starting alternating current motor fitted with the latest type of starting switch operated by hand. It is fitted with open circuit and overload circuit breaker. There is also a single-phase self-starting rotary transformer operating an "Otis elevator." This machine demonstrates the utility of single-phase rotaries.

Other special features are: One 30 k. w. high frequency rotary 16,000 alt., either single, two or three-phase, demonstrating the practicability of high frequency rotaries; a 1½ h. p. slow speed ironclad enclosed type motor, direct connected to a standard air-brake compressor for street car work. There are 100 of these now in operation. There is also exhibited the latest type of

direct connected generator, showing brush holder supported by frame. The capacity of the machine is 75 k. w. at 275 r. p. m.; also a 2 h. p. multipolar motor and 22.5 k. w. compound generator, belted type; 1 k. w. and 15 k. w. belted type armature, and a 75 k. w. direct connected type armature; various sizes of the latest patented carbon brush holders; an experimental rotary transformer for lecture, educational and experimental purposes,

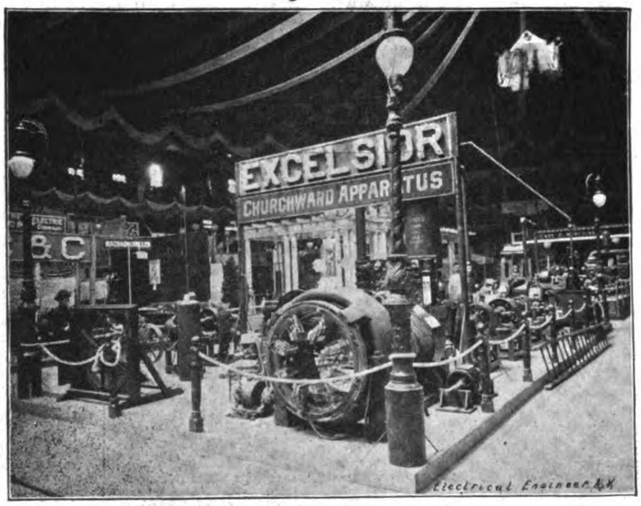


EXHIBIT OF EXCELSIOR AND CHURCHWARD APPARATUS, MAIN FLOOR.

which starts on single-phase and converts to two or three-phase, monocyclic and direct current, or vice versa; also direct current 2 to 3-wire rotary transformer; slow speed 10 h. p. 150 r. p. m. motor for direct connection to tools, etc.; latest type of Excelsior arc machine having a capacity of 100 lamps of 2,000 c. p.; latest type of arc lamps, semi-enclosed, as well as arc motors in operation.

The exhibit was installed under the supervision of Mr. Herman Hochhausen, who also has charge of the exhibit. It certainly shows the resources of the company and the wide scope of their apparatus. Much credit is due to Mr. Alex. Churchward, the electrical engineer of the company, who is the designer and inventor of this admirable lot of electrical machinery.

The Exhibit of H. B. Kirkland.

IN this interesting exhibit, on the main floor, are displayed the goods of several well known concerns, which Mr. Kirkland represents. To the right of the entrance to the booth stands an immense pyramid of The American Circular Loom

COMBINATION EXHIBIT MADE BY H. B. KIRKLAND.

Co.'s flexible conduit, showing to advantage the various sizes in which it is manufactured. At the rear of the booth the Cutter Electric & Mfg. Co.'s circuit breakers and switches are shown mounted as for switchboard use. Like the conduit mentioned above, these goods are too familiar to everybody to need any description. Standing at the left of the Cutter display is a handsome oak case containing a full line of the excellent specialties made by the Solar Carbon Mfg. Co., of Pittsburg. This includes battery, carbons, telephone carbons, carbon brushes, etc. The Hope Electric Appliance Co., of Providence, R. I., show their arc cut-outs and quick break switches in various sizes and types. Taken collectively the exhibit is a very creditable one.

Mr. Frank Loughlin, treasurer of the Solar Carbon Co., was a visitor to the Show last week.

Safety Insulated Wire and Cable Co.

THOSE who remember the exhibit made by this company in 1896 might have expected that Safety would make a striking display, and, in truth, they have not been disappointed. To make an insulated wire exhibit attractive to the layman, is no

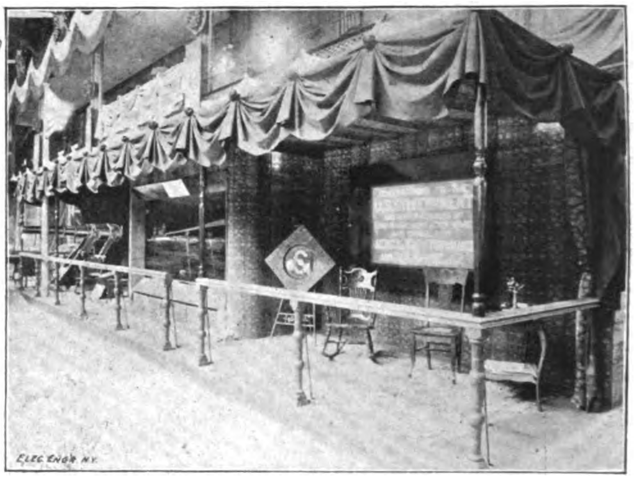


EXHIBIT OF THE SAFETY INSULATED WIRE AND CABLE CO., ARENA CIRCLE.

easy matter, but again the Safety Company have succeeded in doing it in a masterly way.

This company occupy a booth on the gallery floor which is divided into three apartments. In the first is a model of a 4-inch disappearing gun which attracts a great deal of attention. There is also a section of a submarine telephone cable of the

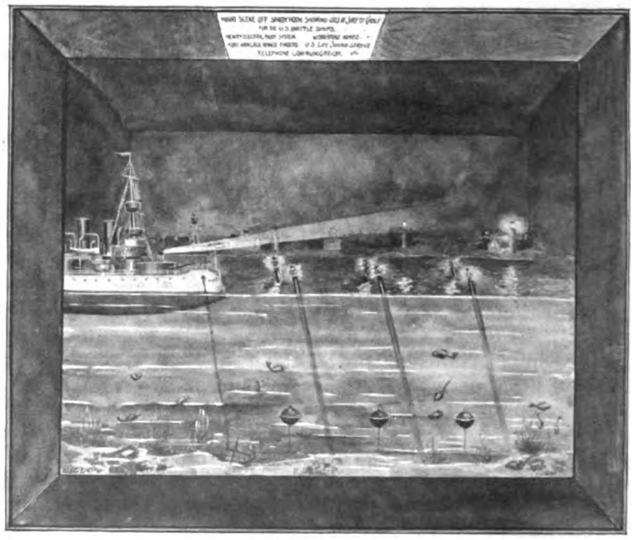


EXHIBIT OF SAFETY INSULATED WIRE AND CABLE CO., SHOWING METHOD OF WIRING SUBMARINE MINES.

future, labeled, "The largest section of submarine cable ever manufactured, and designed for telephone communication between New York and London." This specimen is about 16 inches in diameter, with a core of 66 copper rods about half an inch in diameter, not insulated from each other, however, but having a band of rubber insulation outside, and outside of this strands of large steel bars for strength, then a bed of jute, with outside armor. It has a sectional area of 32,745,913 circular mils, and

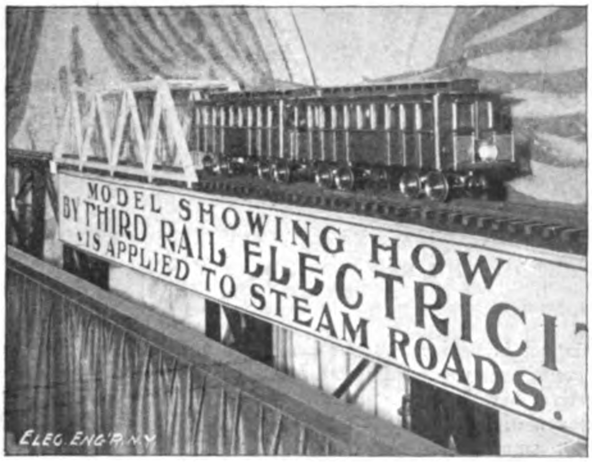
it gives a vivid picture of the difficulties which have to be encountered in transatlantic telephony.

The middle section of the booth presents a most charming and realistic picture, designed to represent a night scene off Sandy Hook, New York. It consists of a tank 12 feet long, 30 inches deep, and 6 feet wide, having a glass front, and filled with water. Through this is shown a shelving bank of sand, with seaweed growing on the bottom and dozens of gold fishes moving hither and thither among miniature submarine mines and electric buoys. Floating on the water is also a model of the battleship "Oregon," with a miniature searchlight mounted on the mast.

The third section of the booth contains specimens of various types of insulating wire manufactured by the company, of which it supplies large quantities to the Government for submarine work. Specimens of all varieties of electric light wires and conductors for high tension transmission are also shown.

Third Rail Model at the Electrical Exhibition.

IN many noteworthy respects the present Exhibition differs from that of 1896, but perhaps in none more than in its inclusion of railway apparatus. It goes without saying that the exhibition is rendered far more complete, for while actual cars and machinery are shown in operation, the public is also able, from a model, to see how the third rail is operated. In the Assembly Rooms, immediately adjoining the Moore Chapel, and in fact with delicious but unavoidable incongruity running right along the outer wall of that famous sanctuary, is a very neat and handsome model intended to exhibit the operation of the third rail system of electric traction as in use by the New York, New Haven & Hartford R. R. Co., on its branch line between Berlin, New Britain and Hartford. The power current passes along the centre rail to the sliding contact shoes



THIRD RAIL MODEL AT THE ELECTRICAL EXHIBITION.

which are seen under the car trucks. A flexible cable from each shoe conveys the current up to the motor and lights. The current returns from the cars by way of the trucks, wheels and outer rails. The change of direction of movement of the model is accomplished by an electro-magnetic reversing switch, which may be seen in the middle of the combination car. This switch performs three functions: reversal of the motor, interchanging the headlight and the rear light, and selecting the signals.

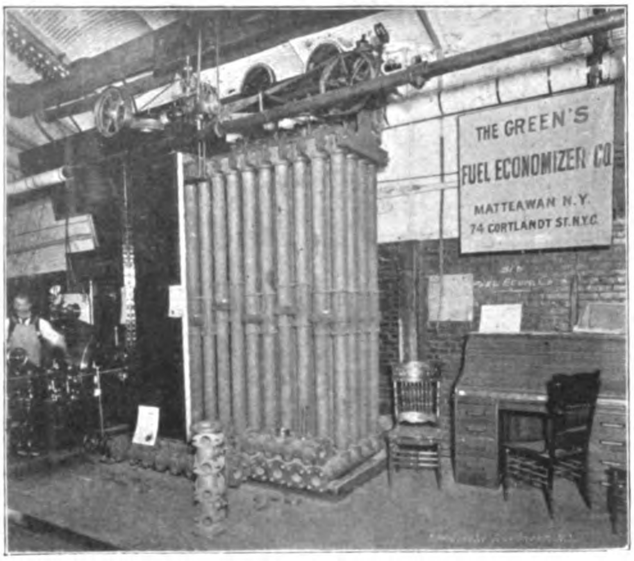
The discontinuance of the third rail at the crossing causes no interruption of current, as the first contact shoe makes contact on the forward rail before the third shoe has left the rear section of rail.

There are two cars, one of which carries the motor and the other is for passengers only. The motor car, as very often in electric railway practice, is a combination car, smoker, etc.

The track is 5-inch gauge, and nearly sixty feet in length. The model as seen in operation, has been furnished by Mr. H. V. Parsell, Jr., E. E. Some details of apparatus as used in the actual working of the road, are also shown through the courtesy of Col. N. H. Heft, in charge of the electrical department of the N. Y., N. H. & H. (Consolidated) R. R., New Haven, Conn. The road is shown with a regular bridge crossing. The whole thing is fenced in by a hand rail and is in charge of an attendant who explains the features of operation to the large and inquiring crowds.

Exhibit of the Fuel Economizer Co.

THE Fuel Economizer Co., of Matteawan, N. Y., sole makers of Green's fuel economizer in this country, show one of their standard economizers of small size containing forty-eight pipes made up in twelve sections, four pipes wide; also a section of their sectional covering, which takes the place of the ordinary brick wall. This covering is made up of sheet steel with two inches of non-conducting material in the centre. Should any accident happen to the headers or pipes, any of these sections can be unbolted in a few minutes and an examination made, and if necessary the header and pipes can be withdrawn sideways. They also show one of their patent headers with valves in position. This header enables the economizer to be worked either with mechanical circulation or without. The valves in headers are connected together by levers. When the headers and pipes require blowing out for cleaning purposes,



THE FUEL ECONOMIZER CO.'S OPERATIVE EXHIBIT, BASEMENT.

the levers are moved, instantly opening the whole of the valves and leaving a clear passageway in headers for the water to pass out. This apparatus is very simple and works well in practice. Briefly explained, the Green economizer utilizes the gases that usually go directly from the boiler up the chimney. The economizer is a nest of pipes built in a flue, the gases passing between the pipes. The feed water circulating through and inside the pipes extracts the heat from the gases in their passage between the tubes. Automatic scrapers are used to remove all soot that might collect on the outside of the tubes.

This apparatus has been applied to over 200,000 boilers and is working in all parts of the world. The Fuel Economizer Co. express their willingness at any time to guarantee a saving of 10 per cent. in fuel, where the very highest type of boiler, and where triple or quadruple expansion condensing engines are used. In some cases as high a saving as 30 per cent. is made, but where such high saving is effected, the boilers are either of a crude type or worked much above their rated capacity.

Last week they sold three economizers for 2,500 boiler horse power, where the coal only costs about 12 cents per ton delivered on the boiler house floor. The exhibit, which is located in the generating section, is in charge of Mr. W. Downs, the New York representative.

B. F. Kelley & Son's Berryman Heaters.

MESSRS. B. F. KELLEY & SON, of 91 Liberty street, in this city, are showing their well known fuel saving device in the generating section.

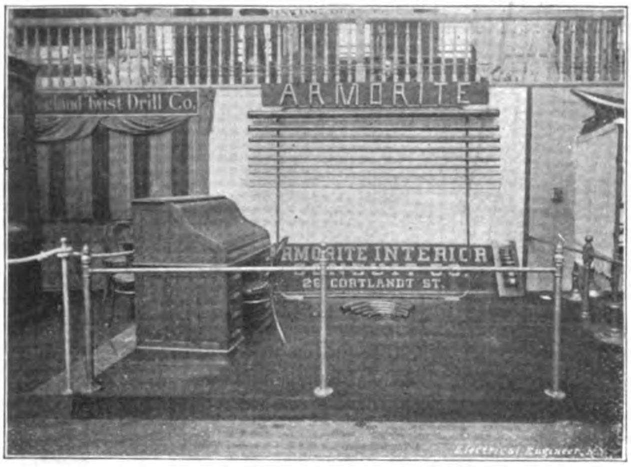
It is the improved Berryman (Kelley's patent) water tube feed water heater and purifier of 300 horse power capacity, supplying hot water for the exhibition steam boilers.

The water when entering the heater is cold, and by the ingenious construction of this apparatus and the aid of exhaust steam it is almost instantly heated to about the boiling point. It is a little giant at heating and purifying water and keeping

steam boilers clean and free from scale. At their exhibit, where the other specialties manufactured by the firm are shown, the great contrast between the "old style" Berryman and the "improved" is attracting the attention of the mechanical engineers. Any information can be obtained from their representative, Mr. information can be obtained from their representative, Mr. George Ernst, at the Garden, or direct from the main office.

Exhibit of the Armorite Interior Conduit Co.

An exhibit which is attracting a great deal of attention on account of the unique display is that of the Armorite Interior Conduit Co., 26 Cortlandt street, New York. The exhibit is located on the main floor to the right of the main

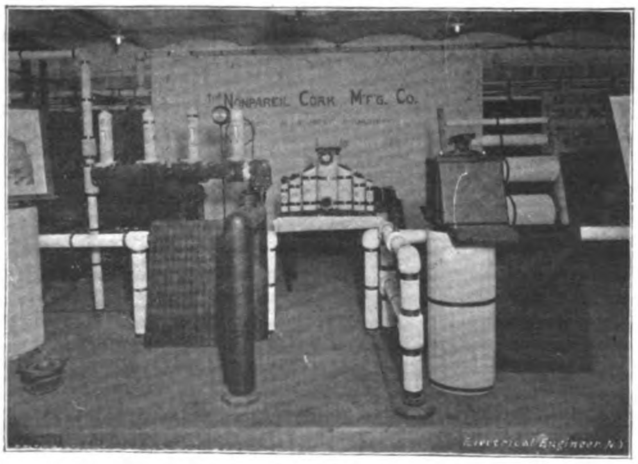


THE ARMORITE INTERIOR CONDUIT CO.'S EXHIBIT.

entrance and on a rack at the back of the booth are arranged a number of samples of Armorite conduit of different sizes and 10 feet long. There are also shown a number of armor-duct enameled tubes and plain and asphalted conduit tubing and fittings.

Exhibit of the Nonpareil Cork Mfg. Co.

One of the exhibits in the generating section, which has attracted a great deal of attention on account of the novelty of the product shown and the great variety of its uses demonstrated, is that of the Nonpareil Cork Mfg. Co., of Bridgeport, Conn. They are showing sectional cork covering for steam and brine pipes, cork sheets for lining the walls of ice houses and refrigerating plants, cork tiles for flooring and insulations for third-rail system. The covering is claimed to be more durable,



THE EXHIBIT OF THE NONPAREIL CORK MFG. CO.

efficient and economical than any other pipe covering, as was shown by a severe test of the several materials in use. It is easy of application and light. The process of manufacture consists, in part, in subjecting the sheets to great heat while under pressure. This, by liquefying the natural gum of the cork, forms the interstices between the granules into small closed air spaces, without destroying the myriads of minute air cells which give cork its wonderful heat non-conducting properties, and without the addition of any foreign cementing substance, produces a solid sheet or block of cork.

As 4 inches of granulated cork are reduced to 1 inch thickness, it is not difficult, even for those whose experience with insulating materials is limited, to appreciate the advantage obtained by using Nonpareil Sheet Cork. The company are prepared to furnish samples of their covering for test to anyone on application, and they have taken numerous large orders at their exhibit, showing that the engineers who have attended the show appreciate the merits of the cork covering.

New York Safety Steam Power Co.'s Exhibit.

Occupying a very prominent and spacious corner in the generating section is the exhibit of the New York Safety Steam Power Co., of 107 Liberty street, New York. They show in operation one of their new type 13 x 12 vertical automatic cut-off heavy duty engines direct connected to a 75 kilowatt Fort Wayne generator. This engine is of the heavy railway type, extra heavy shaft, crank pin, crosshead pin and boxes. It is fitted with the improved Nichols governor. It is simple in construction and has few parts to get out of order. Its

EXHIBIT OF THE NEW YORK SAFETY STEAM POWER CO., BASEMENT.

regulation is perfect, as the governor will regulate within 1½ per cent. from no load to 25 per cent. overload. Their representative, Mr. John T. Simons, reports to have received orders for seven of the company's engines since the exhibition opened, besides smaller engines of this type, a number of which are shown in the space. Being the only vertical steam engine exhibited, it has attracted a great deal of attention and has received many favorable comments.

Le Valley Vitae Carbon Brush Co.'s Display.

An exhibit which has attracted considerable attention is that of the Le Valley Vitae Carbon Brush Co., 39 to 41 Cortlandt street, New York. In a number of glass cases in the front of the booth are shown the various styles and sizes of the company's carbon brushes and commutator compound. The Le Valley Vitae brush differs entirely from all other self-lubricating brushes. There is not a drop of grease or animal oil employed in the treatment; consequently the segment strips or commutator will not clog or gum. The brush lubricates constantly and uniformly as it slowly wears away, preserving at all times an even, bright and polished surface. It never crumbles nor cuts in the least possible manner. In using this brush the commutator is somewhat discolored by the lubricant, but an examination will show that there is no oily or gummy substance on the surface of the commutator; and this discoloration can be easily wiped off with a rag, showing the surface of the commutator much brighter, smoother and cleaner than ever before.

The wear of the commutator with the use of this brush is almost imperceptible, and as this slight wear is uniform and

smooth, it requires no sandpapering or turning down, thus preserving the commutator almost indefinitely.

The company have received many flattering testimonials, one of which states that one of the company's carbon brushes was used on a railway motor which ran the car over 6,000 miles of track and the brush only wore down ¼ inch. In the back of the booth is hung a large carbon brush and all questions are cheerfully answered by Mr. E. J. Prehn.

Exhibit of the Standard Fire Proofing Co.

THE Standard Fire Proofing Co., of 39 Cortlandt street, New York, and Perth Amboy, N. J., who created such a sensation of late with their vitrified and salt glazed underground conduits, have a very neat exhibit on the main floor of the Garden. One of the most remarkable products of the company is a duct 18 inches long with male and female thread. The salt glazed conduits are manufactured from the finest quality of fire clay, mixed and prepared in machines especially constructed for the company's use. They are properly dried, thoroughly and uniformly burnt, heavily glazed inside and out. They are made in any length desired up to six feet in 2, 3, 4 and 6 ducts, perfectly aligned. The outer walls and partitions are 9-16 inch

EXHIBIT OF THE STANDARD FIREPROOFING CO.

thick. The duct or opening is 3¼ inches by 3¼ inches, with rounded corners. The alignment of the conduits is perfect, the ends fit exactly and are provided with openings for the use of iron dowel pins. The partitions add to the solidity and strength and give immense bearing strength. A six-foot-six-duct conduit laid on supports with 5½ feet between bearings will support eight tons. Laid on a smooth bed of concrete there is no limit to bearing strength.

The construction of the multiple of ducts affords an economical means of laying, no high-priced labor being required. The interior is heavily glazed and the round corners of the ducts reduce the friction to a minimum, thereby reducing resistance and saving wear on the cable, also permitting manholes to be placed far apart. There are no sharp points to catch and tear cables.

The cables can be pulled in with little resistance and no wear. Manholes can be placed far apart. They are proof against frost. heat, water or acids. All questions relating to the conduits are cheerfully answered by Mr. M. J. Harrington.

Exhibit of the American Electric and Novelty Co.

IF there is any one exhibit which brings out in a striking manner the use of electricity for decorative and display purposes, it is that of the American Electrical Novelty and Mfg. Co., of New York. In a handsomely decorated booth on the main floor there are shown a large number of potted flowers, illuminated from within and behind by miniature electric lights concealed from view. The power furnished for these lamps is also cleverly concealed.

These plants, used for decorative and advertising purposes, cuits are employed, in which case both wires are lassoed.

There are also shown night lamps, and the well known "Ever Ready" electric light, which is put up in bicycle lamps, electric gas lighters and other useful forms. A striking feature of this exhibit is a figure of Uncle Sam holding under his arm a telescope so well lighted with the "Ever Ready" electric light, that apparently he would have no difficulty in finding with the help of this instrument the lost, strayed or stolen Spanish fleet.

Drop Forgings Exhibited by J. H. Williams & Co.

A VERY tastefully arranged and highly original exhibit is that of J. H. Williams & Co., Brooklyn, N. Y., manufacturers of drop forgings. At the back of the booth is hung a large colored picture showing one of the immense forge rooms of the company. Around the frame of the picture are placed miniature incandescent lamps and the effect is very pleasing. Around the sides of the booth are hung panels, covered with samples of the numerous products of the company, such as eyebolts, engineers' wrenches, special forgings for all kinds of electrical apparatus, made to order, lathe dogs and spanner wrenches. One of the latest pieces of apparatus manufactured

THE EXHIBIT OF J. H. WILLIAMS & CO.

by the company is the Vulcan patent drop-forged steel chain pipe wrench for gripping, turning, or holding pipe, bolts, bars, shafts, etc., from ⅛ to 12 inches in diameter, with either cable or flat link chain. These wrenches combine the merits of all other chain pipe wrenches with special advantages of their own. They are strong and durable, made wholly from wrought steel. The drop-forged jaws are of saw temper; the teeth can be sharpened by filing only. The pressure of the teeth is in a line tangent to the circumference of the pipe; which, combined with the encircling grip of the chain, prevents crushing.

On standards in front of the booth are mounted imitation guns, the gun itself consisting of a field magnet forging and the wheels of drop-forged gear wheel blanks. The exhibit is attracting a great deal of attention, and the many questions asked are always cheerfully answered.

Garvin Machine Co 's Exhibit.

THE exhibit of the Garvin Machine Co., Spring and Varick streets, New York, is very attractive and also neatly arranged for their rather confined space. It has proved especially interesting to the large number of practical men and mechanics of numerous concerns who have visited the exhibition, and it shows a great stride made recently by machine tool builders.

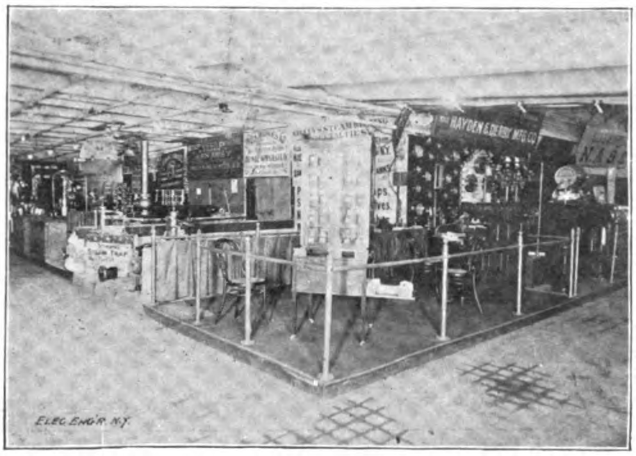
Two machines are shown; an automatic tapping machine and a wire feed screw machine, both used very largely in electrical manufacturing. The automatic tapping machine embodies many new features and as it runs at a speed never obtained by hand machines, it is a great time saver. The spindle is arranged so that by an adjustable stop on the upper end it is tripped and reversed automatically at any point in the operation. The screw machine shown is the smallest size built and is complete with wire feed, spring collet chuck, cut-off cross slide, revolving turret, oil pot, friction countershaft, etc.

Printed matter and catalogues of their large line of lathes,

planers, shapers, drill presses, milling machines, turret lathes, gear cutters, wire coilers, profilers, cutter grinders, die slotters, presses, shears, etc., are distributed by Mr. H. W. Holbrook, who is in charge of the exhibit.

Steam Specialties Exhibited in the Generating Section.

OUR illustration below shows a corner in the generation section in the basement and includes the following exhibits: The Nonpareil Cork Mfg. Co., described elsewhere; L. Katzenstein & Co., showing their metallic packing for pistons and valve stems, flexible tubular metallic packing, metallic gaskets and slip joints for steam pipes; Adam Cook's Sons, exhibiting samples of Albany cylinder, machinery and dynamo oils, ammonia cylinder and olive oils; the Monarch Manufacturing Co., whose exhibit will be described later; the William S. Haines Co., exhibiting the well known Heintz steam traps, thermo regulators and thermometers; Keiley and Mueller, showing a great variety of Keiley specialties, such as reducing valves for all purposes, all kinds of steam traps, cham-



ONE CORNER OF THE STEAM APPLIANCE EXHIBITS IN THE BASEMENT.

pion return steam traps and boiler feeder, positive acting pump governing water pressure regulator and water feeder, improved climax damper regulator, multi-tubular oil and grease extractor, improved steam separators, standard tubular water arch for steam boilers and the Empire drain trap; the Vacuum Oil Company, showing a great variety of lubricating oil and compounds; the Consolidated Safety Valve Co.'s, the Hayden & Derby Mfg. Co.'s and the Ashcroft Mfg. Co.'s joint exhibit of steam engine and steam boiler attachments and gauges described in a previous issue; the Borne, Scrymser Company, showing samples of sperm engine, cylinder, brilliant machinery and high pressure Arctic machinery oils. Adjoining this exhibit are the headquarters of the National Association of Stationary Engineers, whose meetings are held every evening in the rooms adjoining the Concert Hall.

Various Other Exhibits.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING CO., manufacturers of the well known Habirshaw wire and cables, have an exhibit to the left on entering the main floor, where are shown in a large glass case numerous different types of cables and coverings manufactured by the company.

THE WARD ARC LIGHT CO. have their booth stationed on the left hand balcony. The various kinds of arc lamps manufactured by the Ward Co. are here exhibited together with the Washington Carbon Company's products. The special feature of this exhibit is the powerful searchlight, which is said to give 100,000 candle power.

THE AMERICAN PULLEY CO., whose factories are situated at Philadelphia, Pa., have an attractive exhibit on the main floor, where they show the different kinds of pulleys which they manufacture. These pulleys are very extensively used throughout the world and have always given entire satisfaction.

THE SAMSON CORDAGE CO. have their exhibit at the rear of the main floor. Trolley and arc lamp cords and ropes together with their other well known products are shown in a handsome glass case, which has attracted the attention of all visitors to the show.

THE WILDAY ELECTRIC ENGRAVING CO. have their beautiful exhibit on the main floor, where they show to the visitors the art of engraving on metals of various kinds. They sell many beautiful souvenirs, such as match boxes and cigar cases, on which they engrave the name of the purchaser free of charge. This exhibit has attracted the attention of every visitor at the show on account of the use of the electric motor for engraving purposes.

THE AMERICAN ECONOMIZER, illustrated herewith, and built and exhibited by Broomell, Schmidt & Co., Ltd., York, Pa., was described and its merits pointed out in our issue

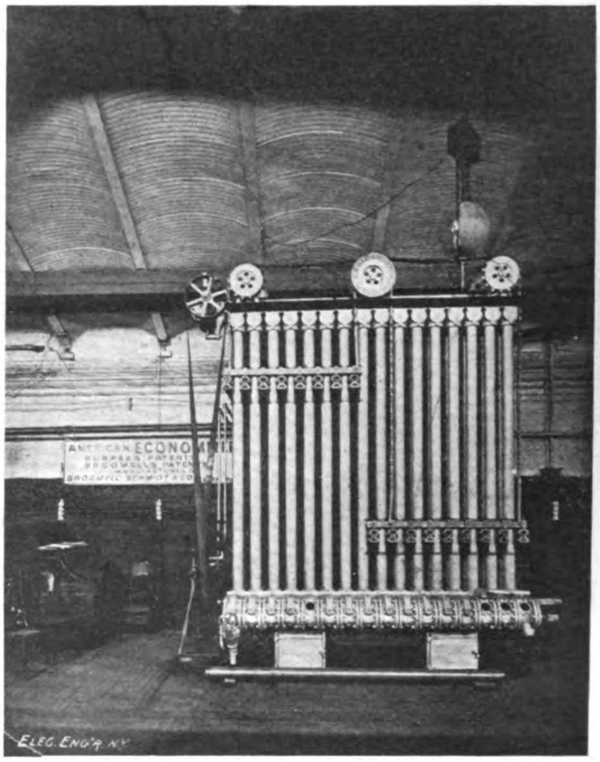


EXHIBIT OF THE AMERICAN ECONOMIZER CO.

of May 5. Since that time the large number of stationary engineers who have attended the Exhibition have manifested a great deal of interest in this fuel economizer and have asked innumerable questions of Messrs. H. Von Mengrenhausen, M.E., and A. P. Broomell.

International Correspondence Schools of Scranton Pa.

ONE of the most interesting features of the Electrical Show is the booth of The International Correspondence Schools of Scranton, Pa., whose New York enrollment office is located at No. 14 East 17th street.

No better proof of the popularity of the methods of instruction employed by this institution could be shown than to see some of their old students taking their friends to have them talked to by representatives of the Schools. The large number of friends they have around them is accounted for by the fact that they have now over 45,000 graduates and students throughout the world.

The correspondence system of education in technical subjects carried on by these Schools, is one of the most successful plans ever devised for giving thorough practical education to wage-earners.

The booth of the Scranton Schools is very attractive. A picture of the school buildings, 5 by 7 feet in size, surrounded by

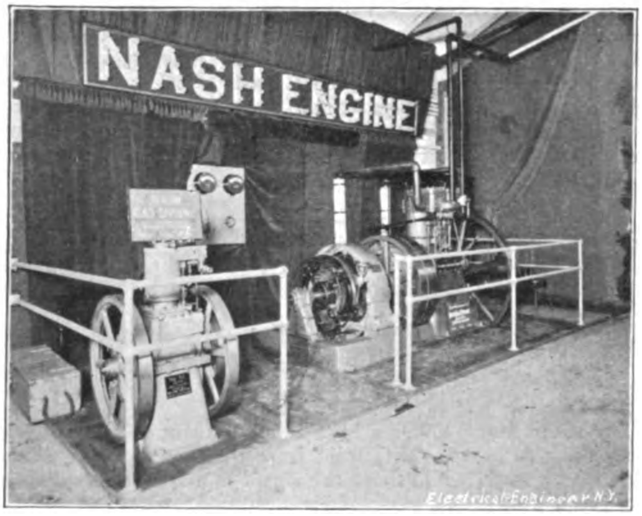
electric lights, showing the picture off to great advantage, hangs at the back of the booth.

The booth is in charge of Messrs. L. S. Harrison, G. J. Mirick and F. S. Lewis, who have been assiduous in their attentions to visitors.

The Nash Gas Engine at the Electrical Exhibition.

THE exhibit by the National Meter Co. in conjunction with the Baylis Company is a 30 horse power vertical double cylinder Nash engine direct coupled to a Walker generator. This exhibit has attracted a great deal of attention on account of the remarkable steadiness of the lights and close regulation from no load to full load. It serves to demonstrate conclusively the practicability of obtaining perfectly steady lights from a direct connected gas engine plant, the results being equal to steam engine practice. The unit shown is representative of a number of plants which have been installed by the Baylis Company in this city and vicinity, several of which have been in operation for the past two years.

The unit exhibited is of 300 lights capacity and occupies a



NASH GAS ENGINE EXHIBIT.

floor space of about 9 x 5 feet. It can readily be seen that such a combination makes an isolated lighting plant possible where lack of space would entirely preclude a steam plant or even a belted gas engine. Running on New York City gas the cost of lighting by means of such a plant is said to be fully 50 per cent. less than the cost of equivalent service from street mains. In the country, where gasolene can be used, the cost of operation is reduced one-half as compared with using city gas as fuel. On a test made at Stevens Institute on a 200 light direct connected Nash gas engine, it was shown that about twice as much light was obtained from incandescent lamps operated from the engine as would result from burning the same amount of gas direct in an ordinary gas burner.

PERSONAL

HON. GARDINER C. SIMS, of Providence, R. I., has been assigned to U. S. S. "Vulcan," and should now be addressed as Lieut. Sims, U. S. N. The "Vulcan" is attached to Admiral Sampson's fleet and her officers and crew are eager for a fight in behalf of Free Cuba. Lieut. Sims has always been prompt to prove himself in every respect a good citizen, and his hosts of electrical friends desire for him a speedy homecoming with many laurels.

MR. HUGO DIEMER has accepted a position with the Westinghouse Electrical and Mfg. Co., at Atlanta, Ga. Mr. Diemer was formerly connected with Diemer & Hebble, representing the Card Electric Co. in the Cincinnati territory.

MISCELLANEOUS

Manufacturers and Dealers in Electrical Supplies in Baltimore—Notes From the Field.—II.

BY C. B. FAIRCHILD.

THE VIADUCT MANUFACTURING COMPANY.

THIS is one of the pioneer telephone manufacturing companies, and still claims to be the second largest manufacturer of telephones, magneto bells, district telegraph messenger boxes, telegraph relays, lightning arresters, and portable police fire alarm and traction telephones, small switchboards for small central stations, etc. Their products go to all parts of this country, to Mexico, South America and Canada. The special claims made for these products are superior material and workmanship, and it is the boast of the manager that they have never had an instrument returned or rejected because of faulty construction.

The main office and store is located on Howard street, while the manufactory is located near the historical Relay station on the B. & O. R. R., nine miles from Baltimore; the name Viaduct is taken from the proximity of the works to the high arch stone viaduct on which the tracks of the B. & O. R. R. cross the Patapsco River.

The buildings are located on the bank of the river at the foot of a high embankment at the south end of the viaduct, as shown some time ago in the pages of The Engineer,

and the tract contains 25 acres of meadow and wild land, in a most romantic and delightful location. The works occupy twelve buildings, including several residences for the men. The works give employment to about 125 hands, many of them being experts in their particular line, some of them having been in the employ of the company for twenty-seven years. For five years the concern was a licensed manufacturer for the Bell Telephone Company.

Water power is employed for operating the machinery, and there are four vertical turbine wheels of the Leffel type. The wheels are located immediately under the building, and operate under a head of seven feet fall, the water coming through a race from a dam located some distance above the viaduct, in quantity sufficient for 200 horse power. The power is transmitted by belts to the main shaft of the power building, and is distributed by belts to the other buildings.

The first, or power, building, is 100 x 40 feet, and to this the

material, consisting of steel bars and brass plates and rods, is delivered. The steel bars are cut up and bent into shape for the horseshoe magnets used in the magneto signal bells. The bars, which are 1¾ x ¼ inch, are cut by means of hand shears into suitable lengths when they are passed through a furnace and after being heated are pressed into shape, when they are tempered and ready to be magnetized, one man being able to bend and magnetize 400 a day. A part of the power building is occupied by the nickel plating department, current for which is derived from a small generator. The burnishing room adjoins this, and the main floor is used for the storage of bars and sheets of brass, of which 300 pounds a day are consumed.

Among the other supplies are batteries, which are bought by the carload, and glass insulators for pole lines. On this floor is an 85-light generator used for the purpose of lighting the works, and a 300-light alternating current generator, which lights the relief office station of the B. & O. R. R., just across the river; there is also a 50 volt generator from which current is used for energizing the permanent magnets. A rotary fire pump and a gas machine complete the equipment of the power building.

The building occupied by the machine shop is 208 x 48 feet, and consists of a main floor and two rooms, one for the packing department and the other for the woodworking machinery. The metal working tool equipment is very complete, there being about 50 small machines, consisting of lathes, screw machines, radial and gang drills, and die punches. Some of the lathes are equipped with an automatic electric device, which rings a bell when a piece of work is finished, so that one man is able to tend three or four machines. The screw machines or turret-headed lathes, having their various tools ready mounted, permit of the cutting of screws and other brass parts very rapidly.

About 35 different types of district telegraph signal boxes are made, some of which are known as "Answer Back" boxes, which give a return acknowledgment signal when a call is made. The output for call boxes is from 8,000 to 10,000 a year, and the capacity for telephones is about 100 a day, complete, including bells, transmitters, receivers and case; recently the company filled an order of 6,000 magneto bells for the Kinlock Telephone Company.

The woodworking department is equipped with a full complement of tools for sawing, planing, dove-tailing and polishing the oak and black walnut for use in making the boxes and cases. Each machine is provided with an exhaust pipe for removing dust and shavings, which are delivered into storage bins outside the room. A kiln for drying lumber stands near the machine shop, and is built of brick.

The finishing department occupies a building 60 x 48 feet, in which the telephone cases are varnished, finished and set up ready for shipment. Nearly all the work in this department is done by hand; there being only one wood-boring machine, which is driven by a C & C motor.

Some of the special features, or rather recent improvement, in the telephones now being manufactured are the use of hard rubber insulation in place of the fibre in the transmitters, and the diaphragm rests against a pocket of carbon shot, finer than that formerly employed, and is known as No. 8. There is a new desk equipment in which the bell is not cut out if the operator fails to hang up the receiver. A special designed stand, with a base switch, is for use in warehouses and building exchanges by means of which any room may be called, but does not prevent another call coming in; it is necessary, however, to adjust the switch properly in order to talk with the new call.

A large number of telephones are now turned out provided with an arm rest, by means of which the contacts are made, the receiver is attached by an ordinary hook, this rests the arm of the operator while talking, and is sure to disconnect when he leaves the box.

Among the specialties are a new portable telephone outfit, which consists of a generator and ringer, receiver of hard rubber, transmitter and one cell of dry battery; the outfit weighs 14 pounds, and is provided with a strap for carrying. This is designed for use by steam and street car conductors, so that they are able to report to the station from any point on the line, contact being made by throwing a wire over the line wire, and making a ground connection, except where metallic circuits are employed, in which case both wires are lassoed.

Another specialty is a Police Fire Alarm and Trolley Signal outfit, in an iron outer shell, for use on poles, in connection with which is used a large vibrating gong, to notify conductors, as they pass a given point, that they are wanted.

Permanent magnets are employed in the motors for operating the call signals, both in the call boxes and telephones, and these after being bent and tempered as described above, are magnetized by being drawn four or five times over the fields of a strong electromagnet, having a core of soft iron, the terminals of which are grooved, and are made adjustable so that grooves of different size may be drawn through them. In constructing the fields of these little motors four horseshoe magnets are employed, the arms of which are from four to five inches in length. These are arranged in pairs, one being inside the other, separated by a short air space. Each pair is laid side by side and fastened at the base with a solid piece on each pole between which the armature revolves. The armature consists of a solid iron core, of peculiar shape, and the wiring is lengthwise, laid in grooves on two sides of the coil. A commutator is placed on the end of the shaft, outside the bearing, and one of the leads from the armature connects with it through the hollow shaft, the other is attached to the case. The gear wheels for a revolving armature are toothed four to one, so that ordinarily in ringing, the armatures make 800 revolutions a minute.

Mr. A. G. Davis, president of the company, is an old-time telegraph operator, having received his first lessons in 1849 from his cousin, the late Samuel F. B. Morse, the father of telegraphy. In his earlier career as a telegraph operator he was stationed two years at Poughkeepsie, N. Y., and afterwards went to Canada and built all the telegraph lines of the Grand Trunk Railway.

THE BALTIMORE CAR WHEEL COMPANY.

This firm are extensive manufacturers of chilled car wheels of all sizes, for steam or street railway service, they also manufacture trucks, both single and double, for electric or cable cars, car axles and chilled brake shoes.

The works are located in the city, near Fulton Junction, at intersection of Pennsylvania and Western Maryland railway tracks, so that sidings from both roads lead directly into the yards, offering excellent shipping facility.

The shops stand under a high bluff of an open tract of land, containing 22 acres. This tract is really a park, being shaded with native trees, while there are shrub bordered walks dividing the green sward. A handsomely designed, large and commodious office building of cut stone is delightfully located at the highest point, some distance back from the main building.

On a high tower near the office is a large tank into which the city water flows, and from which, through an eight-inch main, it is distributed about the buildings for fire purposes, the natural head being sufficient to throw the water 25 feet above any of the buildings.

The machine shops proper occupy two main buildings, that for the machine tools is 66 x 100 feet, two stories in height, while the foundry building is of one-story, 66 x 375 feet, and both are covered with slate roofs. The tool equipment consists of wheel-borers, axle lathes, wheel presses, and such iron working tools as are usually employed in shops of this character, with sufficient wood-working tools for pattern making, etc.

The foundry is provided with two Colliot cupolas, which occupy wings set off from the main shop, and which have a capacity for melting 100 tons of iron per day, or making 400 car wheels per day. The main floor is equipped with numerous cranes for handling the chills and flasks, and for placing the wheels in the annealing pits, which occupy a large space in the floor near one end of the foundry.

The truck department occupies portions of both buildings. The Lord Baltimore type of truck is here manufactured, by which the company is probably as well known, as from their car wheel products. In the construction of this truck, which is illustrated in the accompanying engraving, the side frames are made in one piece, from 4 x 5-inch steel Tee beams forged into the required shape by hydraulic pressure. The frames are reinforced at the bearing points by cast steel yokes 30 inches in length, which carry the journal boxes, and which are accurately fitted to the side beams, having a bearing at top and bottom, and when in place are leaded, making practically a solid weld. The yokes are formed with side pockets which carry graduated spiral springs that rest on the axle box wings, and so carry the entire weight, including motor and truck, making the truck particularly easy on rail joints.

A peculiar and desirable feature of these trucks is the shape and arrangement of the body springs, no spring bolts being employed. These consist of six half elliptical springs, three on each side, as shown in the illustration, and each 36 inches in length; these are flexibly attached to the side frames in such a manner as to prevent all teetering and provide for an unusually long car body. The link attachments for supporting the springs are of cast steel, as are all the adjustable parts of the truck, except the wheels and brake shoes. These spring hanger supports are milled and carefully fitted to the frame; those for the middle spring being first spread and then closed upon the Tee beams and bolted, while those for the end springs are slid over the end of the side beam after being fitted. These, as well as all other parts, are so arranged that no part can fall to the ground should the bolts be removed.

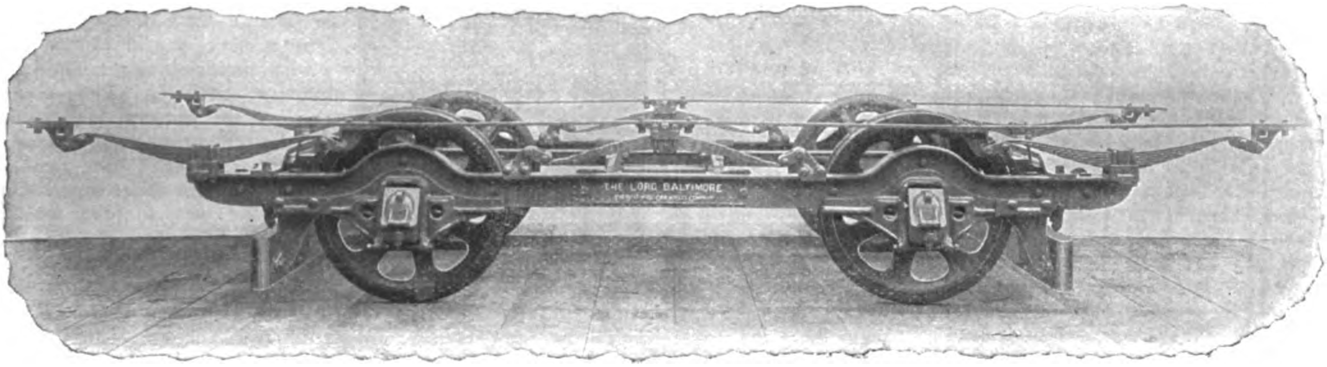
The brake mechanism is of the equalizing type, and all connecting rods are placed above the axle so that no part of the brake mechanism is disturbed when removing or replacing wheels and axles. A convenient method of brake rod adjustment is provided, consisting of a lock nut and split key, which can be manipulated without putting the car over a pit. All pivoted points in the brake levers are provided with case hardened bushings, and the pins, which are of rolled steel, are hardened and pressed in. The end cross bar, which is of rolled steel, serves to brace the truck, the brake equalizing and brake beams are reinforced at the middle with a cast steel plate, which partly embraces the bars and are provided with lugs which support the hardened pins on which the brake-lever is pivoted. Tests show that this bar will stand a load of 17,000 pounds without apparent deflection.

The method of motor suspension is unique, and is easily adjusted, while the axle collar is particularly novel. For this the thimble is pressed on the axle, but carries at its inner end a split ring or collar, which is threaded to the thimble. This split ring is provided with lugs on one side, through which bolts are passed, and when the nuts are turned up hold it firmly in place. Should the collar or face of the motor bearing wear, the collar can be loosened and turned on the thimble, thus bringing it out to any adjustment, when it is again tightened up. The journal box, which is of a special design, manufactured only by this firm, is provided with a hinge cover, but dovetailed to its seat, and drawn down by means of a bolt and nut at the under side of the box. To open the box the nut is loosened when the cover can be slid up slightly and then turned back on its hinges, but it cannot fall off, or be lost on the road.

The double trucks manufactured by this firm are of original design, but are built with the same degree of care as the single trucks. Half elliptical springs are also employed on the double truck, and these are arranged in pairs on each side beneath the bolster, one above and one below the side frames, and are connected by a plunger. Provision is made for leading the brake chain through a case provided within the body centre bearing in which guide wheels are placed, which insures a direct centre pull on the brake beam in all positions, and avoids the use of a compensating yoke or quadrant.

The brake rods are attached to a lever by interlocking devices, which require no pins to hold them in place, so that they are readily detached when it is necesary to remove the truck from the cars. The brake rods are above the axles, as is the case on the single truck.

The single trucks weigh about 5,200 pounds, but when equipped with inside brakes 5,400 pounds. The company manufactures a special type of inside brakes, having a rack and pinion adjustment, and which may be applied to cars that operate over excessively steep grades. The particular claims made by the firm for their trucks are superior material and workmanship, giving great strength, with comparatively few parts, and little or no cost for mainainance.



LATEST FORM OF THE LORD BALTIMORE STREET CAR TRUCK.

MECHANICAL

Receiving Well and Water Tunnel of Allegheny County Light Company, Pittsburgh, Pa.

THIS tunnel is constructed of brick and is circular in shape, having an inside diameter of four feet. The bricks are laid on edge, two deep, with the long sides parallel with the tunnel. At the river end the entrance is through a grating made of iron bars 1½ inches by 2 inches, and placed ¾ inch apart, the ½-inch side facing out. This grating is held by a heavy mass of concrete, foundation of which is laid in the river bed.

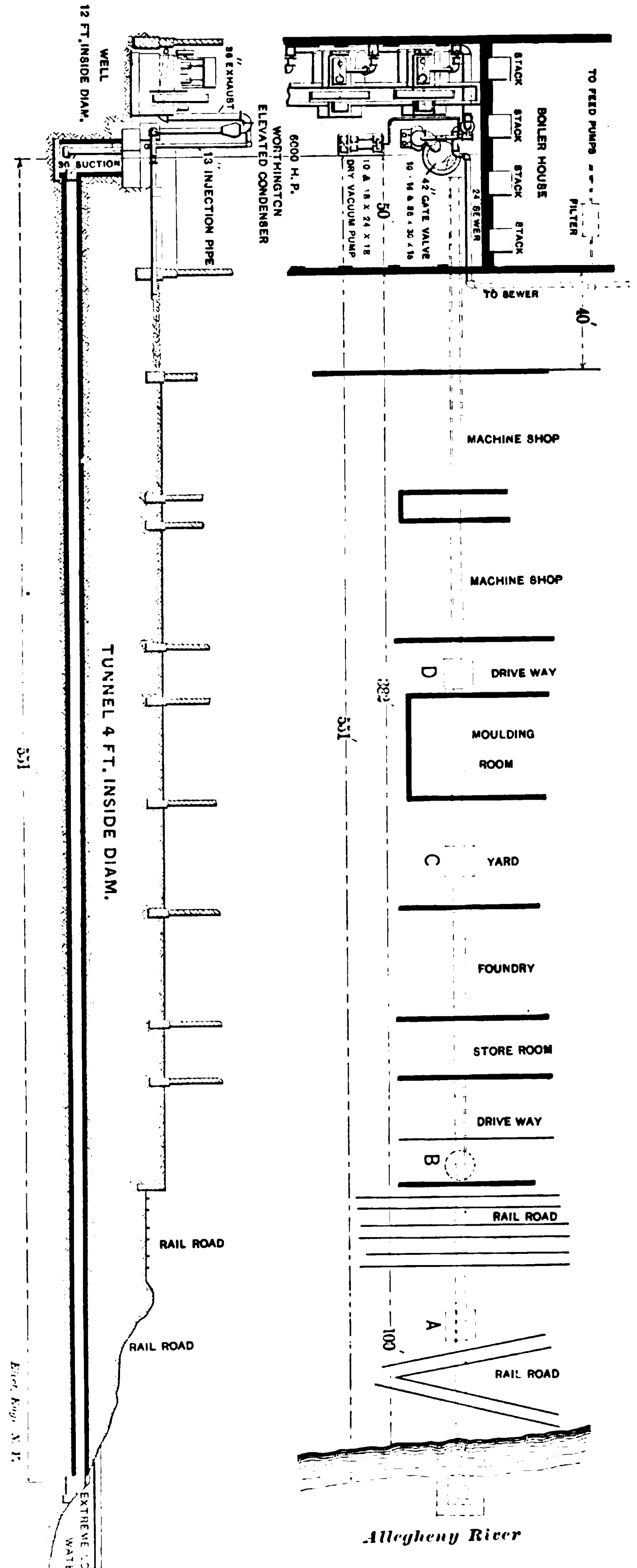
The circular brick arch which forms the tunnel proper starts inside of the mass of concrete and passes under the Junction R. R., McIntosh & Hemphill's plant, and Etna street, a distance of 550 feet, at a depth of about 40 feet from the surface, and ends in a receiving well in the engine room of the Allegheny County Light Company, as shown on the accompanying diagrams.

The entrance to the receiving well is made through a 42-inch gate valve bolted to the end of a cast-iron nozzle which projects through the side wall into the well, the other end of the nozzle being built into the brick work of the tunnel. The receiving well is 12 feet in diameter, and drops from the level of the pump pit floor to a depth of 3 feet 10 inches below the bottom of the tunnel, forming a pocket to allow for the accumulation of sediment from the water. The bottom of the well is of concrete 2 feet 6 inches thick; this also forms the foundation for the side walls, which are of brick and are 18 inches thick.

The location of the circulating pump is such that it was necessary to bring in the opening from the tunnel to one side of the centre (see diagram) to allow room for the screen to pass between the foot valve on the end of the suction pipe and the 42-inch inlet valve. The screen is made in four sections, each section consisting of a yellow pine frame covered with a net of No. 11 galvanized iron wire with a ¾-inch mesh. These sections are held in place by strips of iron which fit loosely into grooves cut in the side pieces of the frames. The strips of iron are bolted to upright pieces, which are in turn supported by cross timbers built into the brick walls of the well. When it is necessary to remove the sections they are slid up and down these strips of iron guided by the grooves in the sides of their frames.

As the river often rises 25 feet above low water mark, and as the level of the pump pit and basement floors would be several feet below the water level at such times, a heavy watertight oak flooring was built around the suction pipes, closing completely the opening of the well, thus preventing the flooding of the lower portions of the plant at high water.

The water for condensing purposes is drawn from the well through a 30-inch cast-iron suction pipe by a 10-16 x 25 x 30 x 18 Worthington vertical pump. After passing through the condenser, a portion of the water is run through a filter and is used in the boilers.



RECEIVING WELL AND WATER TUNNEL, ALLEGHENY COUNTY CO.'S PLANT.

Work was begun at the place marked "A" on the drawing by making an open cut to the river; the tunnel was started from the bottom of this cut. The open cut was dug deeper than the bottom of the tunnel to act as a sumpt to catch any water that might drain through from the heading until the tunnel would be connected to the intake in the river. In this cut was placed a centrifugal pump capable of throwing 2,400 gallons per minute, which kept the water under control.

A shaft was then sunk just inside of McIntosh, Hemphill & Co.'s property, and the tunneling was started from the bottom of both shafts marked "A" and "B." A third shaft was sunk at "C," from the bottom of which the tunneling was started towards "B." It was also started from "B" towards "C." At this time another shaft was sunk at "D," and the work of building a coffer dam around the place in the river where the mass of concrete which forms the intake was to stand.

At this stage of the progress the water became so high in the river that it was impossible to keep the water low enough in the tunnel to allow the men to work. The whole length of the tunnel lies in sand and gravel, some of the sand being a mild form of quicksand through which the water from the river seeps rapidly, necessitating constant pumping. The character of the ground necessitated bracing and sheathing in all tunnels and shafts. After the water took its normal level in the river, work was resumed by starting to dig the well in the engine room. No difficulties were encountered until the work reached a distance of 12 feet from the bottom, when it was found that the sand came in under the sheathing almost as fast as it could be taken out.

SOCIETY & CLUB NOTES

New York Electrical Society Election and Dinner.

President G. S. Dunn.

At the Electrical Exhibition on Thursday evening, the New York Electrical Society held its annual meeting. The reports of the treasurer, Mr. H. A. Sinclair, and the secretary, Mr. G. H. Guy, were read and unanimously accepted. The society was shown to be in sound financial shape and to be growing rapidly. The nominations of the Executive Committee for the officers to serve during the ensuing year were then read, and there being no other nominations, the ticket was adopted with applause. The lecture by Prof. Short, on "Electric Traction," was then proceeded with, Mr. H. B. Coho being in the chair.

The newly elected officers of the Society are: President, Gano S. Dunn; Vice-Presidents, W. E. Case, H. B. Coho, Dr. C. A. Doremus, F. A. Pattison, E. E. Higgins, Chas. Blizard; Secretary, George H. Guy; Treasurer, Henry A. Sinclair.

President Gano S. Dunn has been an active and useful member of the society for some time past and has merited the promotion from the vice-presidency. Mr. Dunn, who is chief engineer of the Crocker-Wheeler Co., is a graduate of the City College and of Columbia University, taking his E.E. degree at the latter in 1891, with very creditable prominence. He has since then paid special attention to design, and his Society lecture on dynamo and motor design has been in constant demand. Mr. Dunn is also an active member of the American Institute of Electrical Engineers. His deep interest in the welfare of the Electrical Society promises it a continuance of the new growth and prosperity it is enjoying.

On Friday evening the society gave a dinner at the St. Denis Hotel, when about 100 members and guests sat down. The dinner was excellently served, the room was tastefully decorated with flags and the tables with flowers, and music was furnished by a small band. Speeches were made as follows: "The New York Electrical Society," Pres. Gano S. Dunn and Secy. G. H. Guy (the latter playing an original composition of his own instead of making a speech); "The American Institute of Electrical Engineers," Prof. F. B. Crocker; "The Technical Colleges," Mr. Joseph Wetzler; "The Yankee Militant," Capt. E

L. Zalinski, U. S. A.; "Sister Societies," Dr. W. McMurtrie; "The Newspaper Man," Mr. S. L. Coles; "Electrical Applications," Mr. F. W. Jones (first president of the society in 1881); "The Electrical Manufacturer," Mr. H. Ward Leonard; "What we Think of Electrical Engineering," Messrs. C. O. Mailloux, for the consulting engineer, and Mr. H. B. Coho, for the electrical contractor. The speaking was brief in each case, but remarkably effective and interesting, and many noteworthy things were said. The proceedings were freely interspersed with music, and the party joined in heartily when national and patriotic airs were played. Altogether the evening was very delightful and marked another stage of advance in the society's history.

Programme of the N. E. L. A. Convention.

WE give below the official programme of the Chicago convention of the National Electric Light Association:

Tuesday, June 7, 1898.—Meeting of the Executive Committee at 9 a. m., secretary's office, Auditorium Hotel. Morning session, 10.30 o'clock, Convention Hall, Auditorium Hotel. Address, President Insull. Paper, Calvin W. Rice, Brooklyn, N. Y., "Cost of the Generation and Distribution of a Unit of Electricity." Topic, "Prices and Discounts for Electric Current and Methods of Billing Current to Customers." Afternoon session, 2 o'clock.—Paper, Alex. Dow, Detroit, Mich., "Public Lighting with Relation to Public Ownership or Control." Topic, "Legislative Policy as to Public Service Corporations."

Wednesday, June 8, 1898.—Morning session, 10 o'clock.—Paper, Herbert A. Wagner, St. Louis, Mo., "General Distribution from Central Stations by Alternating Currents." Paper, Louis A. Ferguson, Chicago, Ill., "General Distribution from Central Stations by Direct Currents." Topic, "Standardizing Apparatus for Central Station Use." Afternoon session, 2.30 o'clock.—Paper, W. McLea Walbank, Montreal, Canada, "Cost of Producing Electric Power by Water Power from Lachine Rapids, Canada." Report, Committee on Standard Candle Power of Incandescent Lamps, Dr. Louis Bell, chairman. Questions and Answers. What Is It You Wish to Know? Executive session. Evening session, 8 o'clock, Auditorium Hall. —Lecture, Joseph Wetzler, "Electricity Direct from Coal" (illustrated with stereopticon).

Thursday, June 9, 1898.—Morning session, 10 o'clock.—Paper, Prof. W. E. Goldsborough, "Transformer Economy." Report, Committee on Amendments to Freight Classification, James I. Ayer, chairman. Report, Committee on Legislation Concerning Theft of Current, James I. Ayer, chairman. Afternoon session, 2.30 o'clock.—Topic, "Freight Rates on Electrical Apparatus." Report, Committee on Finance, James A. Seely, chairman. Executive session. Election of officers.

Prof. S. H. Short Before the N. Y. Elec. Soc.—Electricity Applied to Heavy Railway Service.

DESPITE the abominable weather a large audience assembled in the Concert Hall at the Electrical Exhibition on Thursday evening last to hear Prof. Short lecture before the New York Electrical Society on "Electricity Applied to Heavy Railway Service," and all who came were well repaid for braving the storm. In simple, popular language, but with close precision of date and detail, Prof. Short told the story of the art making it fresh and vivid and so plain that the veriest layman could see how the art had grown and evolved.

Prof. Short went back to the early work of Thomas Davenport and Davidson, and then by rapid stages came down to the great developments which began with his own work and that of Henry, Van Depoele, Daft, and others in the early eighties, with both overhead and under car conductors, until Sprague with his great coup at Richmond convinced the street railway managers that the time had come for the vital change. Prof. Short then noted the next great step forward, namely, the present transition or extension going on, from the ordinary street car service to the cross country system. Attention was called particularly to the development in this respect around Cleveland and to the work at Mason City, Iowa, with a line handling all classes of traffic.

This brought Prof. Short to the competition of the electric road with steam and the beginning of the present era in which the electric motor is slowly but surely eliminating the steam locomotive. He drew attention first of all to the elevated and suburban electric work in and around Chicago, and the development of the modern third rail system and then came down to date with the work on the Brooklyn Bridge and Brooklyn Elevated and that now proposed for the Manhattan system. Then he turned to the wider aspects of this subject by describing and illustrating the work of the New York, New Haven and Hartford Railroad on various branches and sections of main line, and paid a deserved compliment to President Clark and Col. Heft for their boldness and success in grappling with the problems of applying the third rail to regular steam lines.

Prof. Short closed his admirable review of the subject by a luminous discussion of long electric roads and the means for feeding them with current, such as the use of the alternating current with static converters and rotary transformers. He pointed out how the perfection of a synchronous motor would simplify many of the present difficulties; but under any circumstances the reign of electricity on long roads was sure and certain.

The lecture was profusely illustrated by lantern slides under the direction of Mr. Anthony, of the Walker Co., and also was noteworthy as being inclusive of the first kinetoscope pictures ever shown of electric trains in motion at Hartford, Conn., and on the Brooklyn Bridge, in contrast with steam roads. They were received with great applause, the absence of the big clouds of smoke, steam, dust, etc., being very striking. At the close of the lecture, chairman Coho conveyed the thanks of the meeting to Prof. Short for his admirable lecture.

Transportation to the Chicago N. E. L. A. Convention.

We are in receipt of the following from Mr. C. O. Baker, Jr., Master of Transportation:

As already announced, the various passenger associations have granted a rate of a fare and one-third, on the certificate plan, for delegates and their friends attending the Chicago convention, to be held June 7, 8, 9. Arrangements have been made to have the New York delegation leave Grand Central Station Sunday, June 5, via New York Central, Hudson River & Michigan Central R. R., leaving at 1 p. m., on New York, Boston and Chicago special train; Poughkeepsie, 2.43; Albany, 4.20; Schenectady, 5.05; Utica, 7.03; Syracuse, 8.35; Rochester, 10.47; Buffalo, 11.50 p. m., central time; Detroit, 8.00 a. m., arriving in Chicago 3 p. m. Monday. The train leaving Boston at 10.30 a. m. Sunday, June 5, will connect with this train at Albany. This being a limited train, an excess fare of $1 is charged, therefore the railroad fare is $21 and the berth rate $5, making a total of $26. In purchasing tickets, delegates should be particular to obtain a certificate from the agent from whom the purchase is made, as in the absence of such certificate no rebate can be allowed on the return passage. In case the number of delegates attending should warrant, a special train will be run as a second section of the train named. Tickets can be procured at any ticket office of the New York Central Railroad, and space reserved by applying to either the undersigned or to M. C. Roach, General Eastern Passenger Agent New York Central & Hudson River R. R., 413 Broadway, New York.

The Trip to the Northwestern Convention.

Mr. J. M. Hill, of Chicago, informs us that the "Northwest" will leave Chicago at noon on the 10th for the trip up the lakes, and all inquiries as to staterooms, etc., should be addressed to him at 1240 Monadnock block. He says:

"We leave Chicago as originally planned at noon of the 10th, putting in to Milwaukee for such of our members who desire to take the steamer there instead of coming to Chicago. We stop a few hours at Mackinac Island, thence going to Sault Ste. Marie, where we arrive at 5 p. m. on Saturday. The steamer first lands on the Canadian side to inspect the furnaces above referred to, the big plant of the Tagona Company and other points of interest. We are then brought back to the American side, and there will be a formal programme furnished by the citizens of the city on Saturday evening. We remain at this place until Sunday noon, living on board the steamer, utilizing Sunday morning for the inspection of the big locks and ship canal, the carbide works, etc. We arrive at Hancock about 4 a. m. Mon-

day and will be taken early Monday morning to the Calumet and Hecla mines, where we stay until about 2 p. m. During this time the ladies of our party are to be taken care of by the citizens of Hancock and Houghton, the two cities being practically together. We arrive at Duluth on Monday night about 9 p. m., where a great reception is to be given us. A paper on the 'Electrical Smelting of Ores' is to be read at Duluth by Mr. W. S. Horry, and there is to be a varied entertainment furnished by the citizens of that city. The banquet is to be held at West Superior on Tuesday night, and is given by the citizens of both Duluth and Superior. It is to be one of the most elaborate affairs ever given in the West and is to be attended by some very notable men. We leave via special train, stopping some three hours in Minneapolis for the inspection of the new big power plant of the Twin City Rapid Transit Co., and will probably have dinner at the West Hotel, leaving Minneapolis about 8:30 p. m. and arriving at Chicago early on the morning of the 16th."

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued May 24, 1898.

Alarms and Signals:—

ELECTRIC SIGNAL FOR RAILWAY CROSSINGS. L. C. Smith, Columbus, O., 604,431. Filed May 18, 1897. Means whereby danger signaling bells are automatically rung by a passing train, where roadways cross railway tracks.

SECONDARY ELECTRIC CLOCK. A. D. Blodgett, Newton, Mass., 604,453. Filed May 29, 1897. Details of construction.

ELECTRIC CLOCK. W. Whitehead, Manchester, England, 604,508. Filed June 7, 1897. Details of construction.

Batteries, Secondary:—

ACCUMULATOR PLATE. I. Rosler, Berlin, Germany, 604,418. Filed March 10, 1898. Consists of a continuous zigzag core piece, the surfaces of which on both sides are fitted with triangular webs wholly separated from each other.

STORAGE BATTERY. H. S. Lloyd, Philadelphia, Pa., 604,588. Filed Dec. 23, 1896. Comprises a vessel having vertically disposed passages formed by partitions arranged at the sides of the vessel for the escape of any excess of electrolyte and for the passage of the connecting wires.

Dynamos and Motors:

DRIVING MECHANISM FOR DYNAMOS. P. W. Alexander, Allapaha, Ga., 604,511. Filed Sept. 21, 1897. The rotation of the axle of a car is utilized for the running of a dynamo located within the car.

Measurements:—

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,460. Filed March 29, 1897. An alternating current induction motor-meter operating by the inductive action of two magnetic fields of differing phase upon a closed secondary or armature.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,640. Filed Aug. 6, 1897. Similar to above.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,461. Filed Aug. 6, 1897. Similar to above.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,462. Filed Aug. 11, 1897. Consists of an annular armature of low electrical resistance, series coils within the armature arranged on separate axes on opposite sides of the axis of the series coils, and a magnetic field acting at right angles to the axis of the series coils for the purpose of overcoming the friction of the meter.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,463. Filed Aug. 26, 1897. Comprises a revoluble metallic armature, and a series of field coils without armature whose adjacent poles are in close proximity thereto, and in such relation that the resulting intersecting lines of magnetization are at right angles to each other; in combination with an equal number of volt coils located within the armature whose lines of magnetization are inclined to the lines of magnetization of the field coils.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,464. Filed Sept. 11, 1897. Combines series coils connected in series in the main line and conveying the current to be measured, with a pair of shunt coils arranged within the series coils, and a revoluble metallic armature mounted within the shunt coils.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,465. Filed Sept. 24, 1897. An integrating wattmeter of the motor type.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 604,466. Filed Nov. 8, 1897. An integrating wattmeter for measuring alternating electric currents.

MOTOR WATTMETER. C. D. Raab, Kaiserslautern, Germany, 604,501. Filed Dec. 27, 1897. Comprises a disc armature, two horseshoe electromagnets placed near each other at one side of the disc armature and a main current solenoid at the other side.

Miscellaneous:—

VALVE CONTROLLING DEVICE. W. S. Alexander, New York, 604,358. Filed Feb. 24, 1896. A valve of large capacity is controlled through the operation of a valve of small capacity, by the use of a motor operated by the pressure controlled by the main valve and regulated electrically.

ELECTRIC HEATER. E. E. Gold, New York, 604,384. Filed Oct. 14, 1897. Comprises an insulating open work support consisting of a thin foraminous tube, and a helix of resistance wire wound helically around the support, whereby air may circulate about all portions of the heated resistance wire.

ELECTRIC BRUSH. E. M. Hellwig, Chicago, Ill., 604,471. Filed Dec. 11, 1896. A battery is placed within the handle and suitable contacts are provided.

ELECTRICAL LIGHTING DEVICE FOR KEROSENE OR OTHER BURNERS. S. M. Meyer, Brooklyn, N. Y., 604,626. Filed Jan. 27, 1897. Details of construction.

Regulation:—

ELECTRICAL GOVERNOR. M. A. Replogle, Akron, O., 604,544. Filed Feb. 10, 1897. Comprises an electrical governor having a pair of electromagnets, a pair of insulated electrical contact points by means of which electrical circuits may be completed through the magnets, the insulating contact points being separately adjustable and jointly movable.

Switches, Cut-Outs, Etc:—

AUTOMATIC RESETTING FUSIBLE CUT-OUT. J. D. Holmes and W. L. Heath, St. Louis, Mo., 604,616. Filed April 12, 1897. Comprises a rotary member, radial fuse holding arms pivotally mounted thereon to swing in radial planes, the rotary member being normally locked against rotation, and means for releasing it when a fuse is burned out.

Telegraphs:—

COMBINED TRANSMITTER AND RECEIVER. J. M. Joy, New York, 604,533. Filed June 21, 1897. Of the "page printer" class. Details of construction.

Telephones:—

AUTOMATIC TELEPHONE EXCHANGE. W. Decker, Owego, N. Y., 604,373. Filed March 25, 1895. Electrical impulses are caused to operate a step-by-step movement to connect a terminal of one line to a terminal of another line.

TELEPHONE SIGNAL SYSTEM. W. A. Stilwell and A. Barneck, Salina, Kan., 604,434. Filed Nov. 10, 1896. A series of subscribers' stations are connected with a central station, and means are provided whereby any one subscriber can connect his telephone with any other subscriber at will.

MULTIPLE TELEPHONY AND TELEGRAPHY. R. Pfund, New York, 604,499. Filed Oct. 22, 1897. Details of construction.

Vacuum Tube Lighting:

INCANDESCENT ELECTRIC LAMP REGULATOR. D. McF. Moore, New York, 604,679. Filed Feb. 10, 1892. Consists of the combination with the filament thereof, located within an evacuated bulb of circuit breaking terminals outside of the bulb in free air, and means for automatically maintaining vibration of the terminals relatively to and from each other.

ELECTRIC LAMP REGULATOR. D. McF. Moore, New York, 604,680. Filed Oct. 13, 1894. Similar to above.

INTERRUPTER FOR ELECTRIC LIGHTING SYSTEMS. D. McF. Moore, Newark, N. J., 604,681. Filed Dec. 3, 1895. Comprises an interrupter loosely pivoted in a sealed receptacle, an armature borne thereby, and a pair of actuating magnet poles arranged on opposite sides of the magnet being in circuit independent of the interrupter contacts.

MAGNETIC CIRCUIT BREAKER. D. McF. Moore, Newark, N. J., 604,682. Filed Sept. 8, 1896. Designed for use in vacuum tube lighting systems.

MAGNETIC CIRCUIT BREAKER. D. McF. Moore, Newark, N. J., 604,683. Filed Sept. 8, 1896. Means to utilize each half vibration of the contact tongue to effect an interruption of a circuit.

AUTOMATIC VIBRATORY INTERRUPTER. D. McF. Moore, Newark, N. J., 604,684. Filed Dec. 17, 1896. Comprises an operating magnet in the circuit, including the interrupter contacts, and a jarring device for insuring continuous action of the interrupter.

ELECTRIC LIGHTING APPARATUS. D. McF. Moore, Newark, N. J., 604,685. Filed Feb. 15, 1897. Comprises a rotary circuit interrupter working in a sealed receptacle, designed to secure a very rapid and uniform rate of revolution of the inclosed parts of the device without rotation of exterior masses surrounding the receptacle and without the use of motor commutators within the inclosed space.

APPARATUS FOR PRODUCING LUMINOUS OR SIMILAR EFFECTS. D. McF. Moore, Newark, N. J., 604,686. Filed July 3, 1897. Comprises a circuit interrupter in an exhausted receiver, a magnet for the operation of the interrupter and devoid of inductive effect upon the circuit, and a separate magnet acting inductively upon the circuit, the operating and inductive magnets being placed in branches of the circuit, but both in circuit with a contact of the interrupter.

CIRCUIT INTERRUPTING MECHANISM. D. McF. Moore, Newark, N. J., 604,687. Filed Sept. 9, 1897. Comprises a vacuous receptacle, a circuit interrupter therein, a motor for driving the interrupter also located in the receptacle and having the coils thereof insulated by and thoroughly imbedded in a vitreous mass.

CIRCUIT INTERRUPTER. D. McF. Moore, Newark, N. J., 604,688. Filed Sept. 10, 1897. Consists of a metallic foundation and sections of porcelain which have a fused or fired connection with the metal.

THE STOCK MARKET

The Tale of a Fleet.

The course of the markets may be said to have waited on events in the Caribbean Sea and the disposal of Adml. Cervera's will-of-the-wisp fleet, but doubt as to the Spaniard's position cannot last forever. Meantime stocks have been steady and strong, though a trifle dull. Western Union closed on Friday at 91¼, and General Electric at 36⅜.

Copper, New York, is quoted at 12 cents, and heavy steel rail, Eastern mill at $18 per ton.

BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed a fireproof boiler house for the Hendey Machine Company, of Torrington, Conn.

TRADE NOTES & NOVELTIES

Ericsson Telephonic Head Gear and Breastplate.

The accompanying cut represents the latest Ericsson pattern of head gear and breastplate for switchboard, field, marine and army purposes. The old type of head gear, which the Ericsson Telephone Co. have been selling for the past year, has been greatly improved upon. The advantage is that an operator has both hands free at all times to operate the board, thereby making the service much more rapid. In addition to this, the company are equipping the breastplate with their new knuckle joint head gear and receiver, which conforms with the unevenness of the ear and assists the operator very greatly in adjusting. It also prevents any outside sounds from passing through the ear drum. This is a very valuable feature, and will be appreciated by any operator. Instead of using the lever contact by throwing the microphone forward in a speaking position, it automatically makes its contact. The Ericsson Co. make these of four different types, with differentially wound coils or direct circuits. The whole plate complete, with head gear and receiver, weighs about the same as the ordinary head gear, all being light aluminum plates. Their 1898 catalogue is just about ready for distribution, and the company will be pleased to send it out to anyone on application to their address, 20 Warren street, New York City.

The Thermo Electric Co.

This is the name of the new company just organized to manufacture and sell the improved Cox thermo electric generators under an exclusive license from the patentee.

The president of the new company is Colonel Augustus G. Paine, one of the best known and ablest business men in New York, and who was last year mentioned as a candidate for the Greater New York mayoralty. Colonel Paine is a member of the Union League Club, president of the New York and Pennsylvania Co., who operate enormous paper and pulp mills; a director of the New York Life Insurance Co., the Mercantile National Bank, and many other institutions prominent in the business and financial world.

The company's general manager is Mr. L. S. Langville, a gentleman of marked business ability, who may be depended upon to prove that the thermo electric generator is a factor to be reckoned with among small electric power sources. Mr. Merle J. Wightman is the consulting electrical engineer of the company and Mr. Otto Rothenstein, superintendent of the factory.

The company has fitted up extensive and fully equipped new shops, where they are now turning out in large quantities the Cox thermo electric generators, into which a number of improvements have been introduced, looking to still greater economy and convenience in use. It is now ready to deliver on receipt of order two types of thermo electric generators, each giving 6 watts on closed circuit. The first of these generators gives 5 volts on open circuit and 4 amperes on closed circuit; the second gives 10 volts on open circuit and 2 amperes on closed circuit.

These types of generators are specially adapted for the running of electric fans, for operating local telegraph sounders, for electric bell work, for driving phonographs, for galvanoplastic work, such as gold and silver plating. These thermo generators are also exceedingly well adapted for charging storage batteries for use by dentists, for operating automatic pianos, for X-ray work, etc., in fact, wherever a small and constant source of current is required.

The offices of the Thermo Electric Co. are at No. 102 Times building, New York.

The Warren-Medbery Co.

In our last issue, in describing the new Warren-Medbery inductor alternator, an error of the types located the factory of the Warren-Medbery Co. at Sandy Hill, N. J. It should have read Sandy Hill, N. Y.

PHILADELPHIA NOTES

THE WESTINGHOUSE ELECTRIC and Manufacturing Company is building two three-phase belt driven generators, 500 h. p. each, 3,000 alternations, 2,400 volts, for the Canadian Niagara Power Company at Niagara Falls. The success of the 5,000 h. p. machines built for the Cataract Construction Company has encouraged others to enter the field for harnessing Niagara, who, like the pioneers, come to the Westinghouse Company for the apparatus.

WESTERN NOTES

WESTERN ELECTRIC CO. has issued bulletins as to its alternating current fan motors and arc dynamo regulators, which will be sent to any address.

THE BOULDER ELECTRIC LIGHT CO., Boulder, Colo., who already have a number of Ball engines in satisfactory use, have recently ordered from the makers, the Ball Engine Co., Erie, Pa., a 100 horse power engine arranged for direct connection to a 60 kilowatt General Electric machine.

MR. GEO. M. MAYER, who, it will be remembered, was connected with the Electrical Engineering Department of the World's Fair as chief draughtsman, has been established the last three years in Chicago. He has a model and machine shop making a specialty of developing electrical inventions.

THE PERUNA DRUG MFG. CO., Columbus, Ohio, have recently ordered from the Ball Engine Co., Erie, Pa., and the Siemens-Halske Electric Co., Chicago, two 150 horse power Ball engines direct connected to 75 kilowatt generators, and one 225 horse power engine direct connected to a 150 kilowatt generator.

THE JANDUS ELECTRIC COMPANY report many inquiries for and sales of their enclosed alternating arc lamp. The special points of merit are high efficiency, noiseless, steady burning, and long life. Catalogue and prices will be furnished on application. The Chicago office of the Jandus Electric Co. is at 753 Monadnock Bldg.

THE WESTERN ELECTRIC COMPANY has issued a twenty-four page pamphlet on tools, which contains a most complete list of linesmen's and construction tools, all of which can be furnished from stock. Everyone interested in the construction of electric lines should have a copy and the Western Electric Company will mail one upon request to any one desiring it. This pamphlet is known as Tool Catalogue No. 3.

MR. S. J. WICK, of the Electric Railway Equipment Co., has been in the East recently and has established a factory for building poles at Reading, Pa., which is now in successful operation and working full time. During the month of April alone, 100 carloads of poles were shipped from the Reading factory, and another recent order which Mr. Wick has procured is the individual order of 3,500 poles for the city of Mexico.

THE ELECTRIC APPLIANCE CO. have recently closed a general Western agency arrangement for Armorduct interior conduit, the latest product of the Armorite steel armored interior conduit. The Armorduct is a steel tube heavily enameled inside and outside by a special and exclusive process. The enamel placed on this tube gives a perfectly smooth interior

with a coating which will withstand a temperature of 500 degrees. Bending and twisting the tube will not crack or break the coat of enamel. Further than this the enamel is absolutely proof against the action of cements or acids of any description. The Electric Appliance Company have a very valuable specialty in their Armorduct, and large sales are prophesied.

NEW YORK NOTES.

A FINE ATLAS has just been issued by the American (Long Distance) Telephone and Telegraph Co., the inside pages having excellent large colored maps, while telephonic lines across the United States are shown on the covers. It is is very judicious and timely piece of enterprise.

ADVERTISERS' HINTS

THE VIADUCT MFG. CO., Baltimore, Md., are advertising a telephone outfit for traction systems. It is designed with a view to rough service and durability, and undoubtedly is a success in these points as well as containing many other desirable features.

FOUR HUNDRED WHEELS PER DAY is the capacity of the Baltimore Car Wheel Co., Baltimore, Md. This company is the manufacturer of the "Lord Baltimore" truck and also the Blakistone automatic fender and wheel guard, which has been approved by special municipal commissions.

THE MARYLAND TELEPHONE MFG. CO., 11-13 East Lee street, Baltimore, Md., advertise the Minnis system of telephones and switchboards and the Brown loud-speaking transmitters. Beside the above, they mention new types of intercommunicating and interior sets.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., claim to have the latest thing in interior conduit. This is "armorduct," a heavy steel tube enameled inside and outside by a special process. They say the coating of enamel will not crack in bending, is not affected by acids or currents and remains hard in all temperatures up to 500 degrees.

THE GORDON-BURNHAM BATTERY CO., 594 Broadway, New York, advertise battery fan outfits complete with cabinet connecting cords, etc., and capable of running 150 hours without a renewal of the battery.

LORICATED CONDUITS form the subject of the Central Electric Co.'s "ad" this week. It is described as a hole with an anti-rust ironclad armor, which protects the wire, keeps the current in and the moisture out, and is easy to install. They are carried in their stock at 264-270 Fifth avenue, Chicago.

THE AMERICAN ELECTRIC TELEPHONE CO., 171-173 South Canal street, Chicago, Ill., state that over 500 exchanges use their instruments, aggregating over 100,000 telephones.

THE EDDY ELECTRIC MFG. CO., Windsor, Conn., illustrate their type "G" motors and generators. They are built in sizes ranging from 5 h. p. to 30 k. w., have cast steel magnet frame, self-oiling bearings, laminated armatures, cast copper segments in commutators, and have brush holders of either tangent or radial type using carbon brushes.

THE ELECTRIC STORAGE BATTERY CO., Drexel building Philadelphia, Pa., announce that the New York Edison Co. has contracted for a third battery of "chloride accumulators." It will number one-hundred-fifty cells of 4,000 ampere hours' capacity.

THE CROCKER-WHEELER ELECTRIC CO., 39 Cortlandt street, New York, advertise power generators.

THE STROMBERG CARLSON TELEPHONE MFG. CO., 72-82 West Jackson boulevard, Chicago, advertise complete telephone equipment for all classes of service.

THE NORTHERN ELECTRIC MFG. CO., Madison, Wis., advertise a large variety of dynamos and motors to suit all classes of service.

THE WESTINGHOUSE ELECTRIC AND MFG. CO., Pittsburg, Pa., call attention to their generators for electrolytic work, of which they claim there are more in use than of any other make.

Anchor Electric Co., vs. Horatio C. Hawkes.

A decree for the plaintiff has been ordered by the full bench of the Supreme Court of Massachusetts in the case of the Anchor Electric Co. vs. Horatio C. Hawkes, where the plaintiff in seeking to specifically perform an agreement made by the defendant, asked for an injunction to restrain him from interfering or competing with it in its business for a period of five years from Sept. 29, 1894. Though the agreement was not limited as to territory, and the plaintiff's business extends over the whole country, the court holds that it is a valid agreement, going no further than is reasonably necessary for the protection of its business, and is not void as in restraint of trade. The agreement was made upon the sale by the defendant of his interest in the Hawkes Electric Co. and the consolidation of this company with the Iona Manufacturing Co. and the Brown Electric Co., by the formation of the plaintiff. All officers of the old companies signed the agreement, and the court holds that it went no further than was reasonably necessary to protect the good will of the defendant's corporation, and is enforceable against him.

This case was decided some time ago by Judge Holmes and has now been reviewed by the Supreme Court as noted above.

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Department News Items will be found in advertising pages.

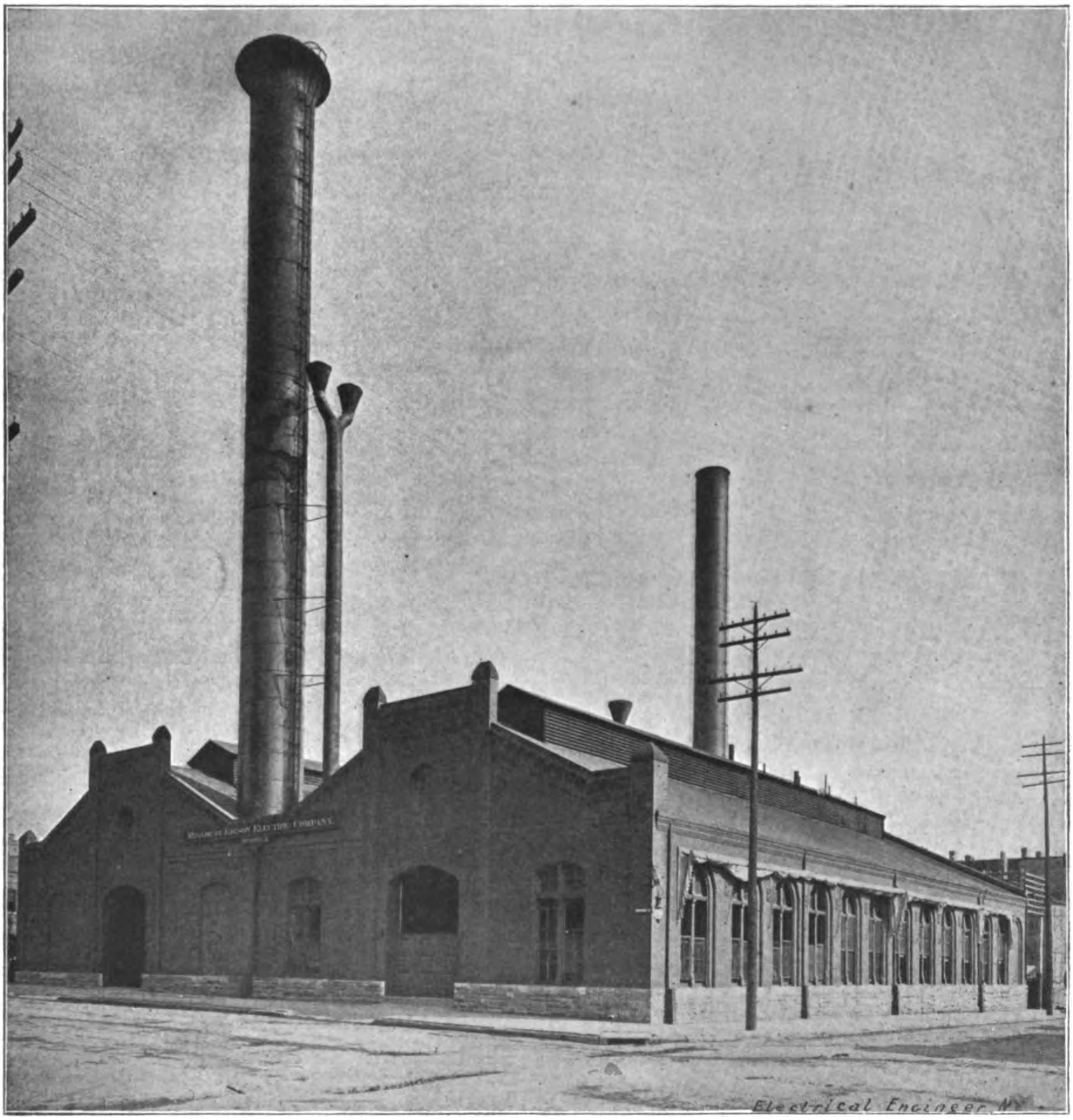
The Electrical Engineer.

Vol. XXV. JUNE 9, 1898. No. 527.

THE MISSOURI-EDISON ELECTRIC COMPANY OF ST. LOUIS, AND ITS DEVELOPMENT OF THE ALTERNATING CURRENT SYSTEM FOR LIGHT AND POWER DISTRIBUTION.

BY HERBERT A. WAGNER.

"ELECTRICITY is in its infancy." How often one hears this expression among that great body of laymen to whom nothing is too wonderful for electricity to accomplish. To those, however, who have acutally followed closely the growth of this infant during the last ten years it must really appear a very precocious child. Almost before Mr. Edison and his co-laborers had perfected a system for the distribution of light and power from central stations, the electrical world was startled by the announcement of the work of Messrs. Gaulard and Gibbs with their alternating current transformer system and the quickly following development by the Westinghouse Electric Company of a comprehensive system of distribution by alternating currents early in the year 1887.



STATION "A," MISSOURI-EDISON ELECTRIC CO., ST. LOUIS, MO.

Since that time the inventions of Tesla and others have so broadened the range of possible adaptations of the alternating current that the future of electrical development would seem to be within its pulsating grasp.

While the manufacturers were busy perfecting new electrical and motive apparatus and devices, it was left to a few pioneer central station companies to develop and perfect the details for the practical distribution of electricity to all parts of a large city and for the various purposes there required. Foremost and largest among these alternating current central stations is the Missouri-Edison Electric Company, of St. Louis. The work which this company has been quietly doing in the last few years has quite recently been causing much comment, and engineers

from all parts of the country are looking to St. Louis as one of the leaders in alternating current distribution for meeting the demands of the industrial and commercial life of the modern city.

The early struggles of this company to obtain apparatus and devices suitable to the requirements of its business and its efforts to assist the manufacturers to improve and perfect the comparatively crude machinery of those embryonic days would fill a good-sized volume, and can therefore only be briefly mentioned here.

HISTORY AND DEVELOPMENT.

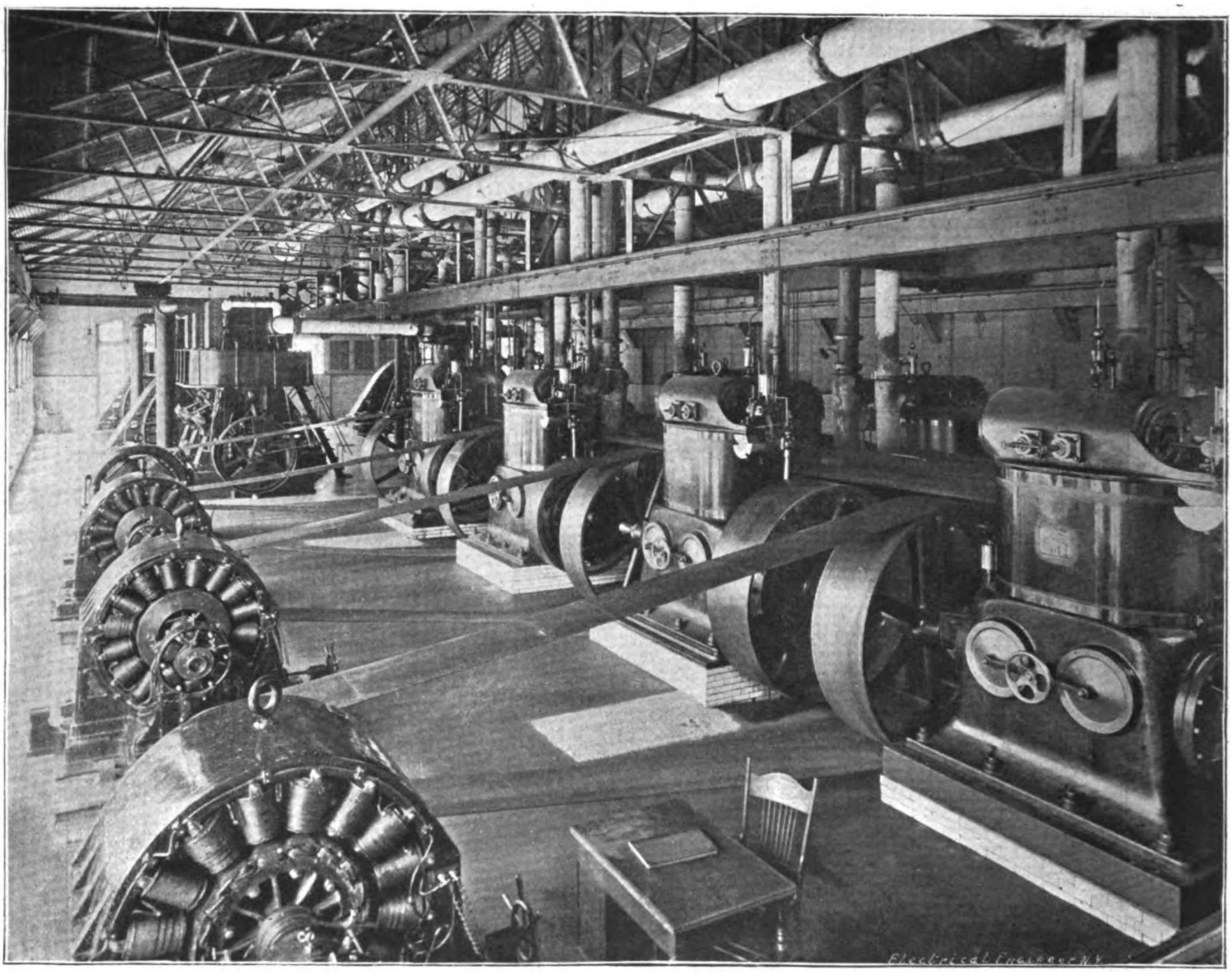
It was shortly after the construction of the first commercially practical alternating current transformers that the writer and a representative of the Westinghouse Electric Company went to St. Louis to endeavor to establish an electric light plant. At that time the practical utility of the alternating current was still looked upon with suspicion, and the low tension advocates were not at all wanting in energy to strengthen and maintain that suspicion.

After much uphill work, the influence of such men as Mr. S. M. Dodd, Mr. J. C. Van Blarcom and others associated with them was secured, and under their able leadership the necessary capital was subscribed, and early in the year 1889 the Missouri Electric Light and Power Company was organized and the construction of its station begun.

All the electrical apparatus for this original installation was bought from the Westinghouse Electric Company, and was of a total capacity of 10,000 16 c. p. lamps. The plant was started in August of the same year and by the end of that year the success of the company seemed assured. The original capital stock was $600,000, and $600,000 of bonds were issued. At the end of the first year the company had 18,910 incandescent lamps connected to its system.

On January 1, 1890, the company entered into a contract with the city of St. Louis for lighting the alleys, public places and buildings throughout a large section of the city at fairly good prices.

The business of the company grew at a rapid rate, and at the end of the second year there were connected to its lines 32,508 incandescent lamps. Station generating apparatus was added from time to time, and the company soon began to pay dividends at the rate of 8 per cent. per annum. The following table shows the increase of the company's business and that of its successor, the Missouri-Edison Electric Company, from 1890 up to the present year:



ENGINE ROOM FROM SWITCHBOARD SHOWING OLD 175 K. W. GENERATORS AND 1,000 K. W. GENERATOR IN BACKGROUND, STATION "A."

	Incandescent. Lamps.	A. C. Arc.	D. C. Arc.	H. P. Motors.
Jan. 1, 1890	18,910	0	0	0
" " 1891	32,508	0	0	0
" " 1892	57,436	0	0	0
" " 1893	73,140	0	0	0
" " 1894	111,940	20	3,306	648
" " 1895	126,475	250	3,144	696
" " 1896	144,144	620	3,055	1,117
" " 1897	156,728	1,668	2,482	1,239
" " 1898	174,265	3,575	1,036	2,390

Early in 1893 the Edison Illuminating Company, of St. Louis, was organized and soon acquired the property of the Municipal Electric Light and Power Company. This latter company had been organized late in 1889 for the purpose of carrying out a contract with the city of St. Louis to light the greater portion of its streets with arc lamps, and the business of the company consisted principally of this and commercial arc lighting, a small

amount of power being furnished from 500-volt generators and a few thousand incandescent lamps being operated from the alternating current system.

In December, 1893, the interests of the Missouri Electric Light and Power Company and the Edison Illuminating Company, of St. Louis, were practically consolidated, although the two companies retained their individual names and corporate existence and continued to be operated independently, but under the direction of the same officers.

In 1897 the Missouri-Edison Electric Company was organized for the formal consolidation of these two associated companies. and soon after the new company also acquired the property and business of the St. Louis Electric Light and Power Company.

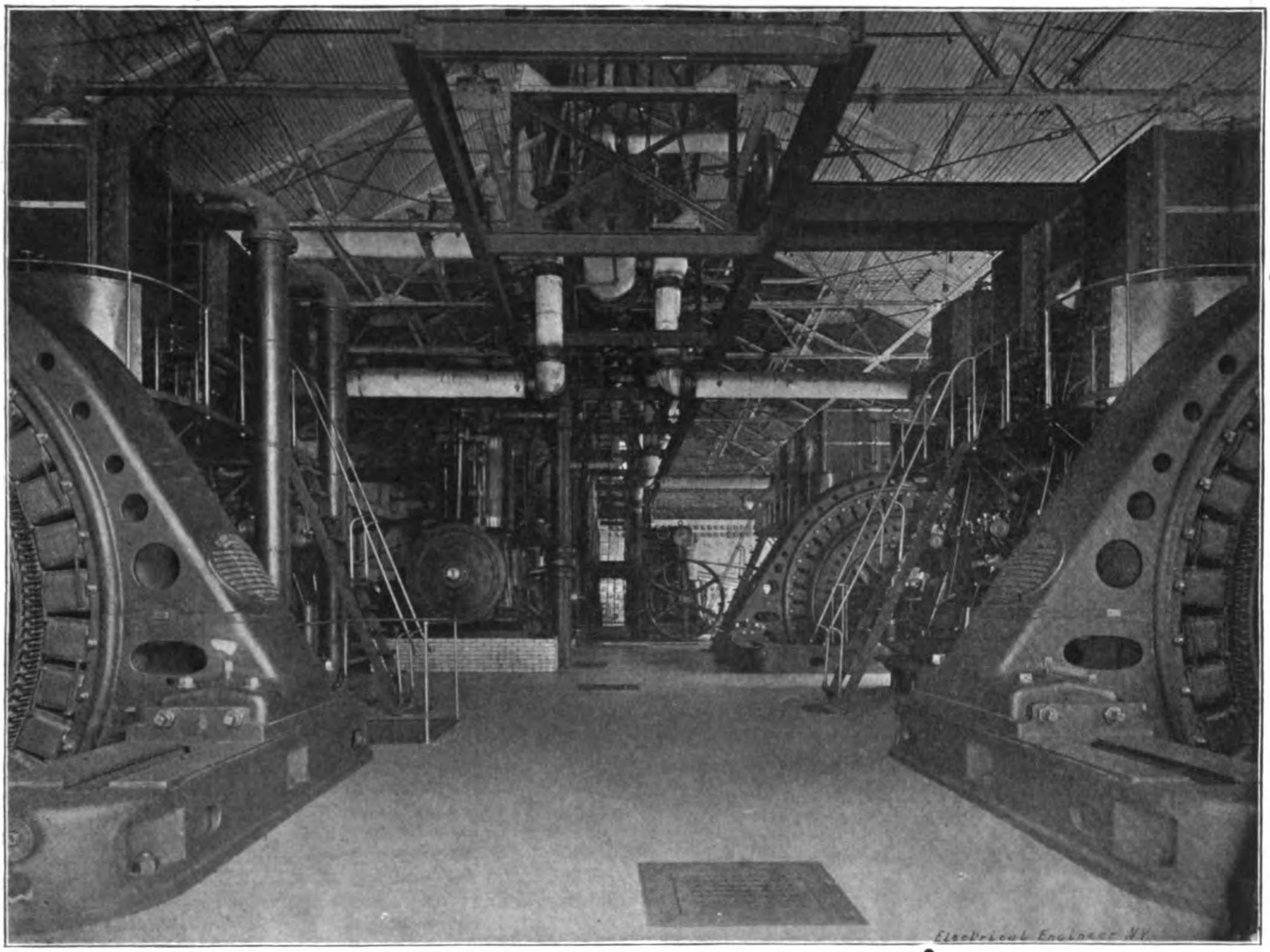
The stations of these several companies before any consolidation took place had steam and generating capacities as follows:

Missouri Electric Light and Power Company, 1893: Engines, 4,100 h. p.; alternating current generators, 40,000 16 c. p. lamps.

Edison Illuminating Company, of St. Louis, 1893: Engines, 4,800 h. p.; alternating current generators, 12,000 16 c. p. lamps; arc light generators, 4,500 arc lamps; 500-volt power generators, 280 k. w.

St. Louis Electric Light and Power Company, 1897: Engines, 1,100 h. p.: alternating current generators, 3,600 16 c. p. lamps; arc light generators, 420 arc lamps; power generators, 440 k. w.

These stations have since all been remodeled and are now known as stations "A," "B" and "C" respectively.



VIEW IN STATION "A," LOOKING TOWARD SWITCHBOARD THROUGH CENTRE OF ENGINE ROOM.

STATION A.

This station was the one originally built by the Missouri Electric Light and Power Company. The building is 135x155 feet, being divided longitudinally into two rooms, one 152x63 feet, containing engine and generator plant and switchboard; the other 152x67 feet, containing the boiler plant. The construction is of brick and stone, with iron and slate roof. The building is of one story and 35 feet high.

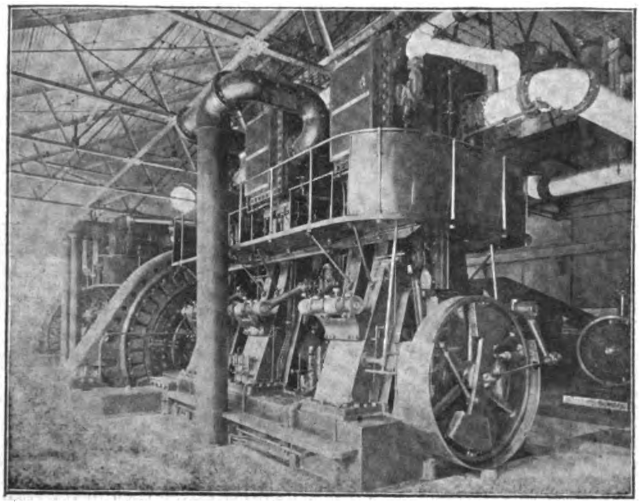
The generating apparatus of this station now consists of three 1,500 h. p. three-cylinder compound engines, built by the Lake Erie Engineering Works, direct coupled to three 1,000 k. w. alternating currents generators, built by the Westinghouse Electric and Manufacturing Company on the designs of the writer; one 600 h. p. Westinghouse compound engine belted to one 350 k. w. Westinghouse alternating current generator; six 300 h. p. Westinghouse compound engines belted to six 180 k. w. Westinghouse alternating current generators; two 300 h. p. Westinghouse compound engines belted to two 200 k. w. 500-volt power generators; three 120 h. p. Westinghouse compound engines direct connected to two 75 k. w. Westinghouse 125-volt direct current generators and one 100 k. w. General Electric 125-volt direct current generator, all three being used for exciters. The steam is generated by eighteen 240 h. p. Babcock & Wilcox boilers, built by the Babcock & Wilcox Company.

GENERATORS.

The 1,000 k. w. generators are designed to operate at a speed of 180 revolutions per minute and deliver current at a pressure of from 1,100 to 1,300 volts at a frequency of 60 cycles. They are of the stationary field type, being similar in design to the modern direct current railway generator of large size, the commutator, of course, being replaced by collector rings. The winding is so designed that these machines may be used either single phase or two phase as desired, the entire amount of copper being utilized in circuit when operated in either way. The rating of these generators is based on their single phase capacity, but a large margin for overload was provided in their design, and they are regularly operated for several hours per day during the winter months at an output of 1,200 k. w. each. With this load

the rise in temperature of all parts of the machines is hardly appreciable.

The armatures are ten feet in diameter and weigh about 80,000 pounds, providing ample fly-wheel capacity within themselves without any additional wheel. The mechanical features of each of these generators are so arranged that the entire field frame may be moved in a direction longitudinally with the shaft, by means of suitable screws, to a position where the armature is



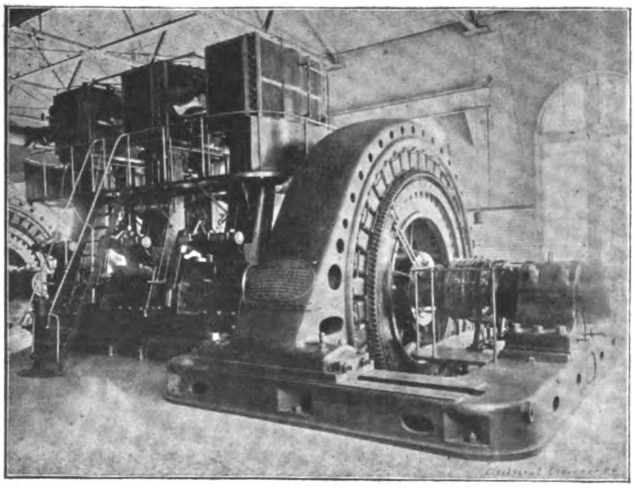
1,500 H. P. LAKE ERIE ENGINE DIRECT CONNECTED TO WESTINGHOUSE 1,000 K. W. GENERATOR, STATION "A."

completely uncovered for inspection and repairs and where field coils may be removed from the pole pieces with ease.

The belted generators are of the general type manufactured by the Westinghouse Electric and Manufacturing Company several years ago. They have stationary fields, and the armatures are of the ironclad type with polar projections. These generators also deliver current at a pressure ranging from 1,100 to 1,300 volts.

ENGINES.

The engines, being provided with three cylinders, distribute the power through three cranks placed at angles of 120 degrees, insuring very uniform angular velocity. With this disposition of cranks and the large fly-wheel capacity provided in the armatures, the variation in angular velocity through different portions of each revolution is less than one-quarter of 1 per cent.



1,000 K. W. WESTINGHOUSE GENERATOR AND LAKE ERIE ENGINE, STATION "A."

This great refinement is unnecessary in direct current practice, but is most essential for the proper operation of alternating current generators in multiple arc.

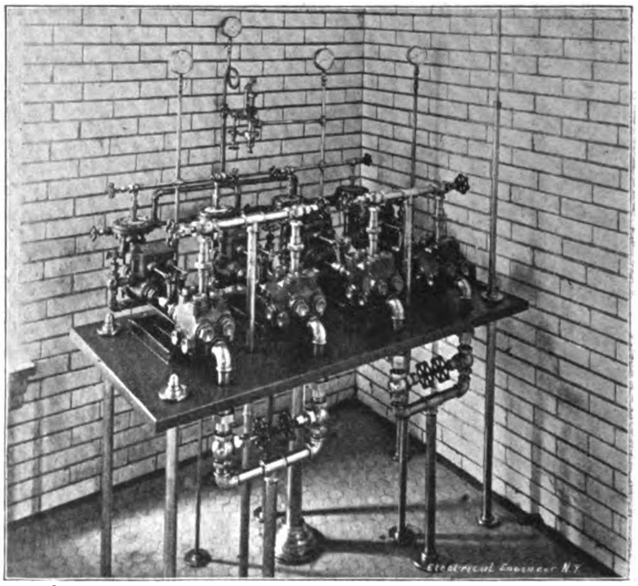
The regulation of the engines is effected by governors of the shaft type, but of special design. Connected to the rocker arm operating the high pressure admission valve on each engine is a double acting air compression cylinder. This acts as an inertia balance to arrest the motion of the valve at the end of each stroke, storing up energy, which is delivered to the valve again on beginning the new stroke. The two ends of this compression cylinder are connected to each other through a by-pass pipe and hand valve, by means of which the amount of compression can be controlled at will. The effect of this inertia balance is to relieve the governor of a great deal of the pressure which would be thrown upon it at certain portions of each revolution. By varying the amount of relief to the governor afforded in this way, by means of the by-pass valve, the speed of the engine may be varied between 5 and 10 per cent. A very effective and accurate means is thus provided for adjusting the engine speed, or causing this speed to remain the same with various loads. This inertia speeding device is the invention of Mr. F. M. Rites, of Ithaca, N. Y.

EXCITERS.

The exciters are of the recent type of direct coupled direct current multipolar generators built by the Westinghouse and General Electric Companies. Each is of a capacity sufficient to excite the fields of all tne generators in the station; two relays, or spare generators, therefore, being ready at all times in case of accident.

BOILERS AND SMOKESTACKS.

The boilers are of the usual Babcock & Wilcox type, and were designed for and are operated at 150 pounds pressure. The furnaces are designed for hand-firing, numerous experiments with mechanical stokers having proved them to be undesirable.



SIEGRIST LUBRICATING SYSTEM, PUMP TABLE, STATION "A."

The smoke and products of combustion are led through underground flues to two steel smokestacks, one 150 feet high by 10 feet in diameter, and the other 135 feet high by 8 feet in diameter. These stacks are bolted at the base to massive concrete foundations, rendering them self-supporting and capable of withstanding the highest wind pressures. They were both built by Riter & Conley, of Pittsburg, Pa., who also provided all the iron work for the roofs.

OILING SYSTEM.

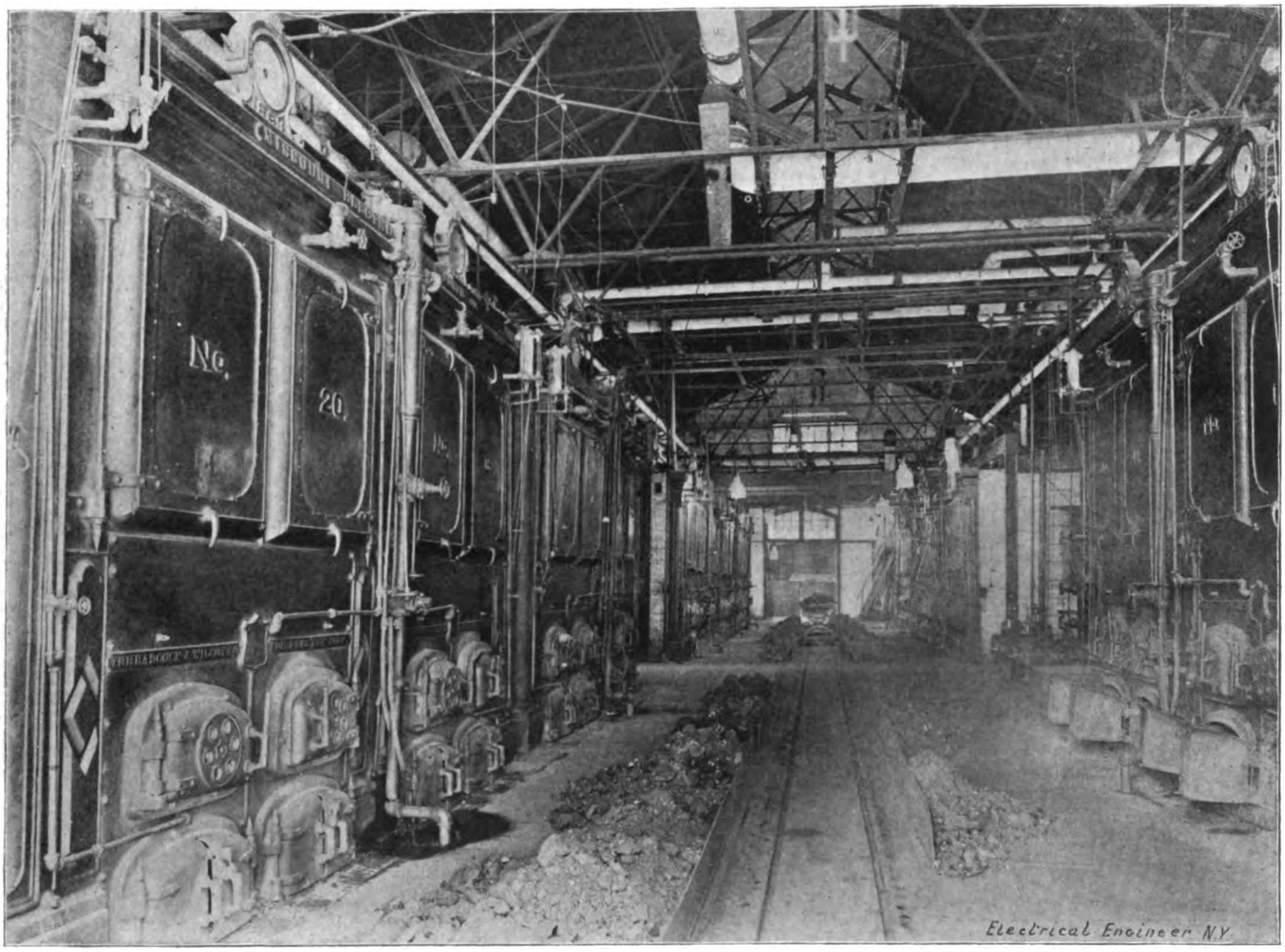
A very ingenious but simple and effective system of oil distribution has been recently installed. This system was designed by the Siegrist Lubricator Company, of St. Louis. Occupying a small space in a corner of the engine room is a slate-topped table holding four of the smallest sized Worthington duplex pumps. These pumps are connected in pairs, one of each pair being reserved as a relay; one pair being designed to pump engine and lubricating oil and the other cylinder oil.

Through suitable piping these pumps are connected to tanks and filters located in the basement. The engine oil is pumped to all necessary parts of each engine and generator at a pressure of 80 pounds per square inch, this pressure being maintained constantly throughout the oiling system, no matter how much or little oil is being used, by means of suitable regulating valves

placed in the discharge pipe of each pump and acting to close or open the steam admission.

At each bearing or part to be oiled is located a sight feed oil cup connected to the oil pipe system. The rate of speed of each oil cup can be regulated at will by a thumb screw provided for that purpose, but a diaphragm pressure valve in each cup instantly closes the oil drip if the pressure in the system is lowered more than two or three pounds. One globe valve placed in the supply pipe for the oil system of each engine is, therefore, sufficient to start or stop all the oil cups in that engine. On closing this valve the oil is stopped within a few seconds at every oil cup whether located on the highest or lowest part of the engine, thus precluding any waste of oil after the engine is stopped. The oil is piped back from all the drips of engines and generators to filters located in the basement.

The cylinder oil is handled in the same way through sight feed lubricators for each cylinder placed at a convenient height from the floor for observation and regulation. The pressure maintained in the cylinder lubricating system is, of course, slightly higher than the steam pressure.



BOILER ROOM, STATION "A," MISSOURI-EDISON ELECTRIC CO., ST. LOUIS, MO.

SWITCHBOARD.

Not the least noteworthy part of this station is the large switchboard. This is built of white Italian marble and is 58 feet long and 16 feet high. It is constructed with two floors at different levels and a liberal basement is provided for cables, rheostats and feeder regulators. The upper portion of the board provides room for 56 feeders and the lower portion will accommodate all the the apparatus for regulating and controlling 15 generators. The board is so designed that all generators may be operated in multiple arc and cut on or off the bus-bar system as the demand for current requires, or each generator may be operated independently of all the others and the feeders grouped at will on any generator desired. The utmost flexibility of operation is thereby provided for. The feeders may be switched at will from any one of the generator busses to any other, or to the general multiple bus without interrupting the current for more than a fractional part of a second. This result is secured by providing individual busses for each generator, in addition to the general multiple bus, to which each generator can be connected if desired.

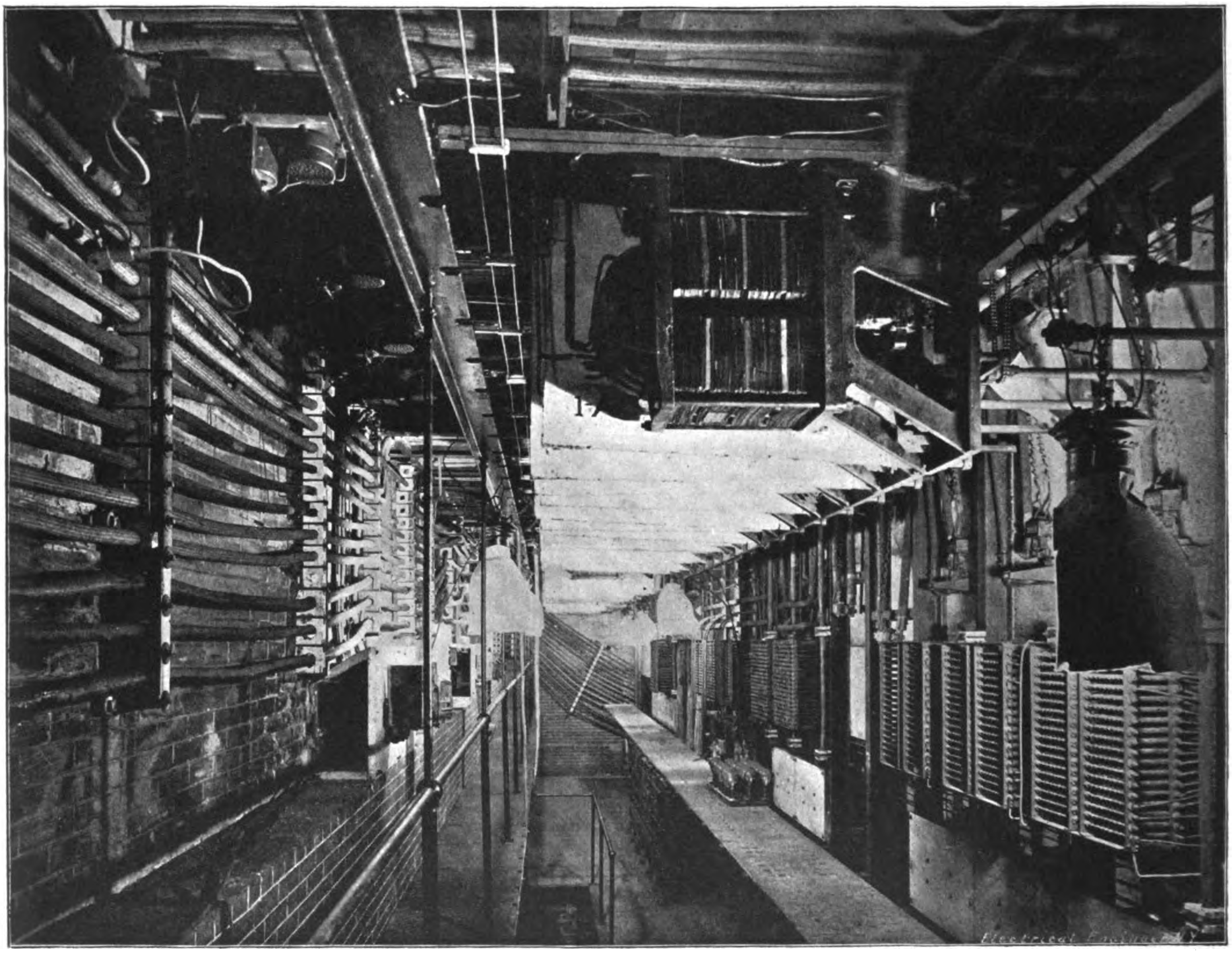
One terminal of each feeder is brought directly to a general bus located on the station wall, to which bus each generator is also connected, and the other terminal of each feeder is brought to a switching device, by means of which it can be connected to any individual generator bus, as already stated. These single pole generator busses are placed on the switchboard proper and the opposite poles are, therefore, separated from each other by a distance of several feet. The feeder switching is done through this arrangement on the single pole principle, thereby saving space and making it possible to get twice the feeder capacity in the same switchboard space than would be the case if the usual double pole arrangement were used.

Each feeder is provided, in addition to its switch, with an ammeter, voltmeter and potential regulator. The potential regulators are of the type invented by Mr. L. B. Stillwell, and each consists of a regulating transformer, which is made by means of suitable switching devices to superpose or add more or less of its secondary potential to that of the feeder. The mechanical details for controlling these regulators are quite novel. Each regulator is hung under and supported by the upper floor of the switchboard and is provided with a switch dial controlled by a wheel on the front of the board within reach from the main station floor. By means of these switch dials the pressure of each feeder may be independently raised or lowered 18 per cent., making a total possible independent variation of 36 per cent.

By the use of an ingenious reversing switch the same transformer winding in the regulator is used for either raising or

lowering the pressure. To prevent any possibility of short circuiting between the regulator terminals when this reversing switch is thrown, the arm controlling it and the main regulator wheel, which both revolve around the same centre or shaft, are provided with a locking device which prevents both from being moved at the same time, or either from being moved when the other is not in a safe position. These regulators take up a space 11 inches in width, and each feeder is provided with a space one foot in width along the switchboards.

The regulators are hung by hooks from the "I" beams overhead in such a way that by raising them slightly by means of a portable windlass placed above, they may be disengaged and lowered to the basement floor. Before doing this it is necessary to disconnect them from the feeder cables and the regulator wheel shafts, all of which can be done in about five minutes. The regulator transformer switch dial and reversing switch are all self-contained and can be handled together. Within fifteen minutes' time any regulator can be cut out of service, removed from the board and another one put in its place.



PART OF SWITCHBOARD BASEMENT, SHOWING FEEDER REGULATORS SUSPENDED FROM FLOOR ABOVE, STATION "A."

During the two years in which these improved regulators have been in constant service it has not been found necessary, however, to cut out or remove a single one, as none have in any instance failed to do their work, and this without attention or repairs of any kind. With the maximum load on a feeder the loss in each regulator is less than three-fourths of 1 per cent. of the feeder load, and at smaller loads the loss is proportionately less.

The entire regulation of both feeders and generators is accomplished from the main floor of the engine room, the second floor of the switchboard being used only when feeder switches are to be thrown, and this is not necessary when the generators are being operated in multiple arc. A gallery is provided at a third level along the rear of the switchboard from which feeder fuses, lightning arresters and ammeters and voltmeters are accessible.

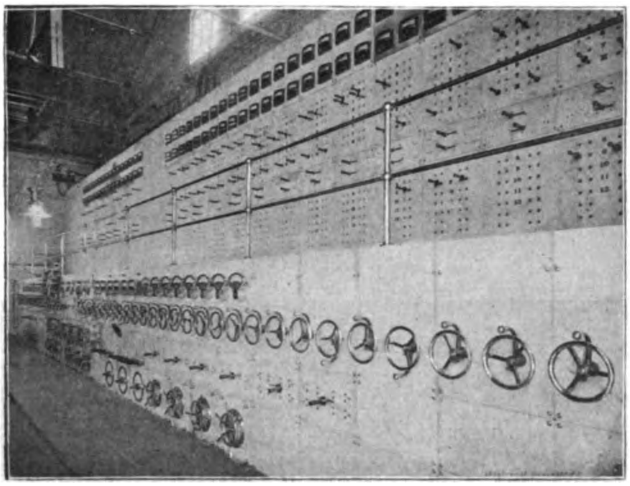
An unusual and very important feature of this switchboard is the fact that there are no parts of any kind carrying high potential current which can be reached or touched by an attendant from any part of the front of the switchboard. All high potential switches are placed in the rear of, or below, the switchboard, the operating handles only being placed on the front.

The feeder ammeters show the ampere load on each feeder, the feeder capacity being limited by the safe carrying capacity in amperes. The output of each generator is indicated by wattmeters, the load on each engine being dependent on the watt output of its generator, the capacity of which is not overtaxed with any load which the engine can pull. In addition to this indicating wattmeter, each generator is provided with a Thomson recording wattmeter, and by means of these recording wattmeters the entire station output is recorded. The voltmeters used in connection with each feeder are made to indicate the exact pressure at the feeder end or centre of distribution by means of pressure wires brought back to the station from such points. No feeder is operated nor regulation attempted without the use of pressure wires. All the indicating instruments were made by the Wagner Electric Manufacturing Company and are of their horizontal scale illuminated dial type, made extremely dead beat by the use of oil in which their mechanism moves and is retarded by suitable aluminum vanes.

This entire switchboard was constructed by the Wagner Electric Manufacturing Company after the designs of the lighting company's engineers. The greater part of the current used for incandescent lighting, constant potential arc lighting and alternating current motors is distributed through this switchboard

from this station. Tie lines of large capacity connect the switchboard of this station with that of station "B."

Opening from the basement under the switchboard and extending at a still lower level is the main cable terminal vault or tunnel, through which all cables are led from the underground conduits to the switchboard. This vault is 50 feet long, 9 ieet



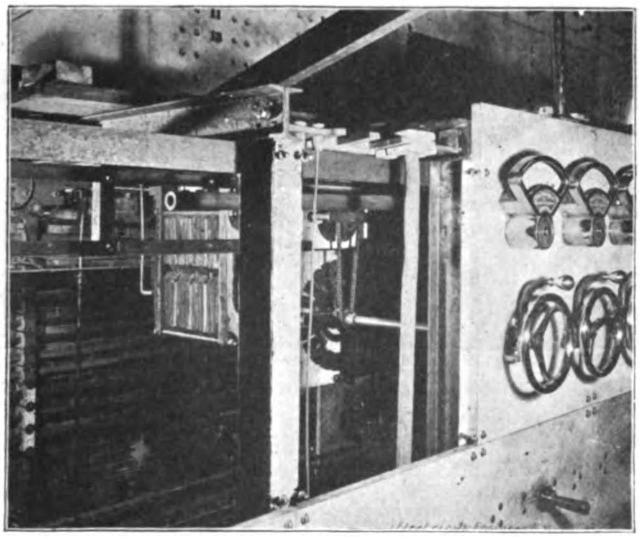
SWITCHBOARD IN STATION "A."

wide and 7½ feet high. Along its side are arranged adjustable cable racks, by which all cables are supported and carried to their proper position on other racks provided under the switchboard, which in turn carry them to their respective panels.

A consiaerable portion of the output of this station is still conveyed on overhead wires, but within three months all currenr will be led out through cables leading from this cable terminal vault.

STATION "B."

This station was originally built by the Municipal Electric Lighting and Power Company. Since the property was acquired by the Edison Illuminating Company, both the building and



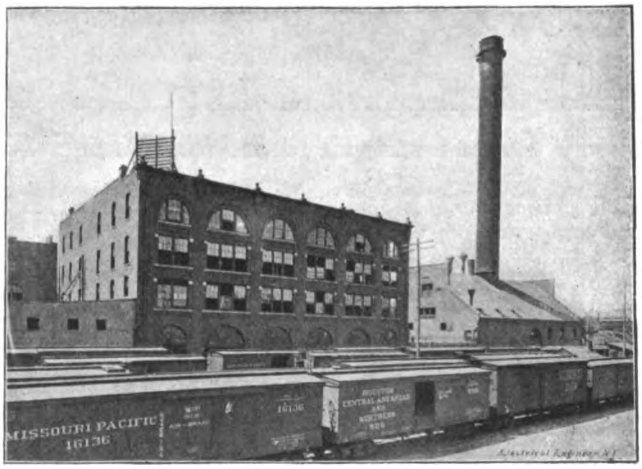
FEEDER REGULATOR, SHOWING METHOD OF HANGING FROM SWITCHBOARD, UPPER FLOOR.

steam apparatus have been almost entirely remodeled and a very large amount of new machinery has been installed. The main building, containing the engine room, is 105 feet long by 96 feet wide, and was originally constructed with four stories. Most of the second floor, which contained shafting and clutch pulleys, has now been removed, thereby increasing the height of the engine room to 28½ feet. Across the street from this building is another, 108 feet long by 57 feet wide, containing the boiler plant. The extreme height of this building is 60 feet. In this are placed twelve 350 h. p. Heine water tube boilers, built by the Heine Safety Boiler Company, of St. Louis. Seven more boilers of the same capacity can be installed in the additional space provided, and as yet left vacant. The floor of this boiler room is 23 feet below the street level, and connecting it with the engine room across the street is a large room excavated under the street, with floor at the same level as the boiler room proper. This room is 50 feet long by 50 feet wide, and in it are located the heaters and the main steam and exhaust pipe lines running from the boiler room to the basement of the engine room. Tne street above is supported by iron columns and "I" beams.

In the engine room are located one 1,500 h. p. cross compound Hamilton Corliss engine, directly connected to a 1,000 k.

CABLE TERMINAL VAULT, STATION "A."

w. alternating current generator, built by the General Electric Company; one 1,500 h. p. simple Hamilton Corliss engine direct connected to one 1,000 k. w. General Electric alternating current generator; one 750 h. p. simple Hamilton Corliss engine direct connected to one 500 k. w. 500-volt direct current General Electric generator; four 650 h. p. simple Hamilton Corliss engines, belted to line shafting on floor above, clutch pulleys on which operate by means of belts forty 60-light Wood arc machines on the third floor; two 100 k. w. 500-volt Fort Wayne bipolar generators; one 80 k. w. 500-volt General Electric multipolar generator, and one 100 k. w. 500-volt Eddy multipolar gen-



EXTERIOR OF STATION "B."

erator are also operated on the third floor in the same way by belts. Two 125 h. p. Westinghouse compound engines direct connected to two 100 k. w. 125-volt direct current General Electric generators used for exciters, are also located on the engine room floor.

Along one wall of the engine room, 18 feet from the floor, is the main switchboard, supported from the wall and partly hung from the girders overhead. On the third floor is located a switchboard used in connection with the arc light machines for series arc lighting circuits. The fourth floor is used for repair shops and storage.

ENGINES.

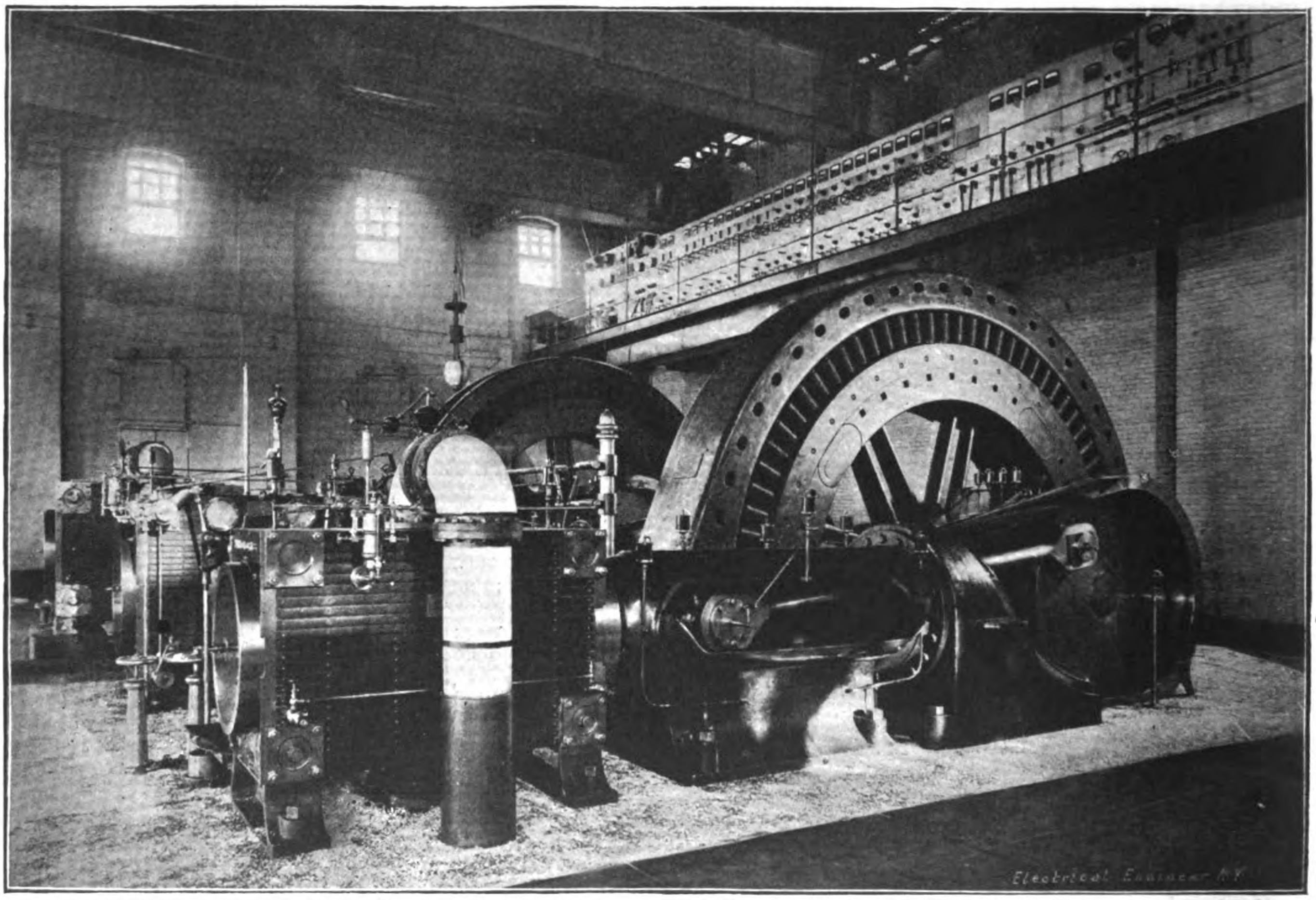
The engines in this station are all of the Hamilton Corliss type, built by the Hoover-Owens-Rentschler Company, of Hamilton, O., with the exception of the two 125 h. p. Westinghouse compound engines, used to drive the exciter dynamos. The two largest Corliss engines are of 1,500 h. p. nominal capacity, running at a speed of 90 revolutions per minute. They can, however, be made to develop 2,000 h. p. each when required. One of the engines is of the cross compound type, with cranks placed at 90 degrees. The other engine is of the simple Corliss type with single crank. This second engine is intended to carry the

STEAM PIPING.

All of the steam piping in this station is placed under the main floor in suitable basement passages between the engine foundations. A duplicate steam pipe system provides each engine with a double steam connection. This duplicate system consists of one 24-inch main steam pipe line and an 18-inch auxiliary line, either one of which may be withdrawn entirely from service for repairs or inspection. The entire steam system from boilers to engines is so designed that any section of pipe can be withdrawn from service or completely disconnected and taken out without interfering in any way with the operation of the plant.

BOILERS.

The boilers are of the standard water tube pattern, manufactured by the Heine Safety Boiler Company, of St. Louis, and are each of 350 h. p. They are placed in batteries of four boilers each, and are connected by steel flues, lined with fire brick, to a single steel smokestack. The furnaces are all arranged for hand



1,000 K. W. GENERAL ELECTRIC GENERATOR DIRECT CONNECTED TO 1,500 H. P. HAMILTON-CORLISS ENGINE, STATION "B."

variable portion of the ordinary station load, so that the compound engine and others of similar type to be added from time to time can usually be kept running at very nearly their rated capacity, as this type of engine when compounded is of lower economy at fractional loads than the simple form.

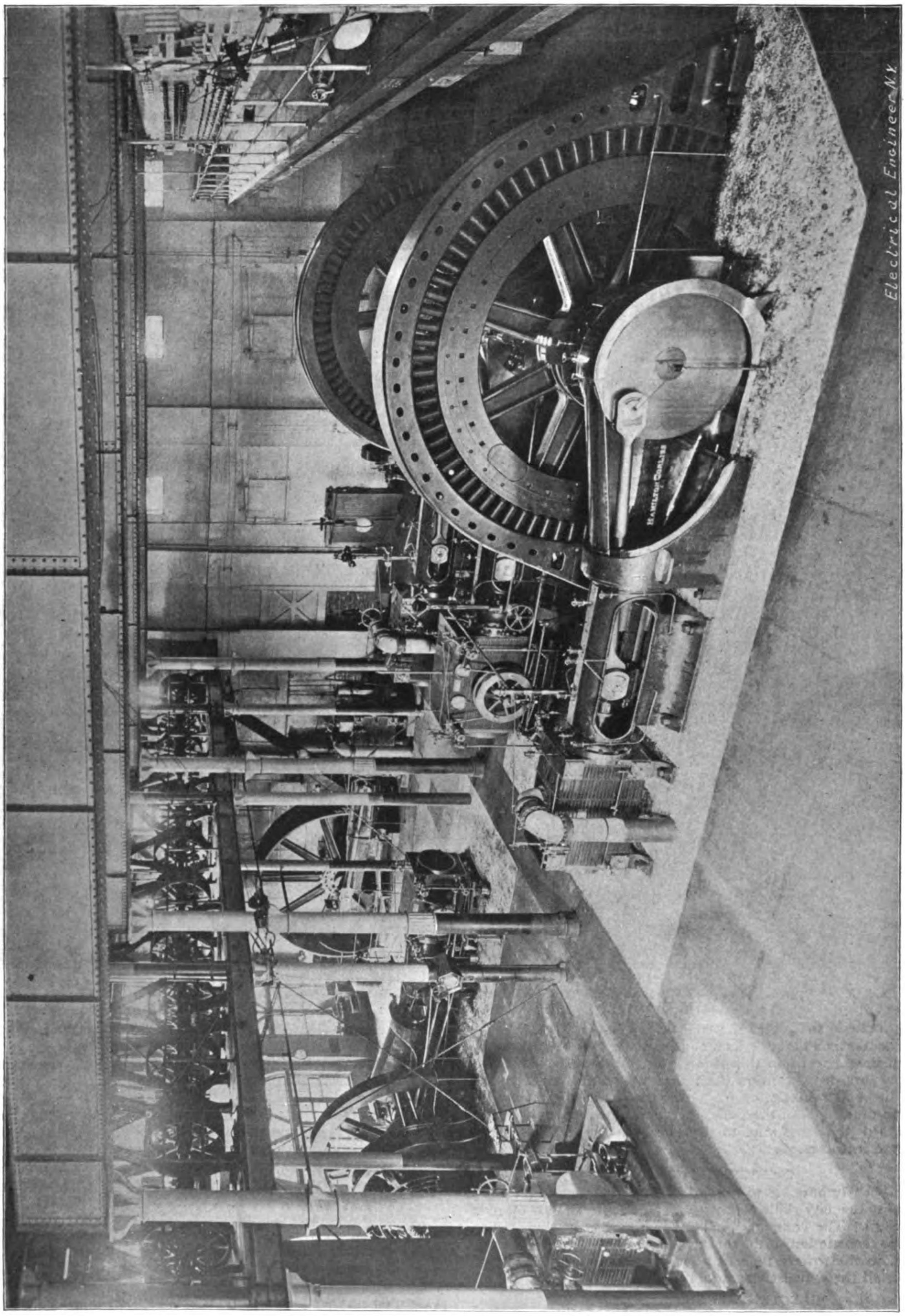
These engines are made extremely massive in all parts and are of the most recent design of heavy duty pattern. Each of these two engines, as before stated, drives a 1,000 k. w. alternating current generator, which will be more fully described further on. No other fly wheels are provided than the generator armatures, which are designed to perform the double duty of armature and fly wheel.

The 750 h. p. simple Corliss engine directly connected to a 500 k. w. 500-volt generator is of the same general design as the larger engines, and also runs at a speed of 90 revolutions per minute. The smaller engines, of 650 h. p. each, are of an older pattern and run at a speed of 60 revolutions per minute. All of these engines are at present operated non-condensing with 150 pounds initial pressure.

firing, experiments with several makes of mechanical stokers having shown that fully as economical results and greater reliability could be secured with the use of the old-fashioned method and usual form of flat grates.

SMOKESTACK.

The smokestack is of steel construction, lined with fire brick to a point 60 feet above the furnace grates. It is 13 feet in diameter and 204 feet high. The base is bolted to massive foundations, surrounded with concrete, covering it to a depth of about six feet. This smokestack successfully withstood the severe tornado which visited St. Louis about two years ago, although it was well inside of the edge of the path of the storm, and most of the buildings surrounding it were unroofed and more or less completely demolished. A massive brick smokestack at a street railway power house, less than a half mile distant, was lifted bodily from its foundations by this same storm and dropped, a shapeless pile of bricks, within 20 feet of its former location. The steel smokestack was originally located centrally in the



PORTION OF ENGINE ROOM, STATION "B," MISSOURI-EDISON ELECTRIC CO., ST. LOUIS, MO.

boiler house, and used in connection with 19 vertical boilers of the "porcupine" type; these were all replaced by the Heine boilers described, and arrangements are perfected to move the stack from its present location to a new position 20 feet to one side. This rather difficult operation is to be accomplished without shutting down the plant, and without depending on a system of guys to support the stack while being moved. The moving is to be done by the use of a great number of small steel rollers, rolling between "I" beams, and the base of the stack is to be weighted sufficiently to assure stability except in the strongest gale.

COAL HANDLING.

Above the boilers a large coal bin is built, occupying the entire width and length of the building. This bin is constructed of steel, supported on "I" beams and columns, the sides being sufficiently inclined to deliver the coal to a central position, from whence it descends through iron chutes to the boiler room floor. Coal can be delivered to this storage bin by means of mechanical conveyors, from cars on the railroad tracks located on one side of the boiler house, or from wagons in the alley running along the other side of the building. The ashes are elevated by conveyors of the same kind to overhead bins, whence they can be dumped into cars.

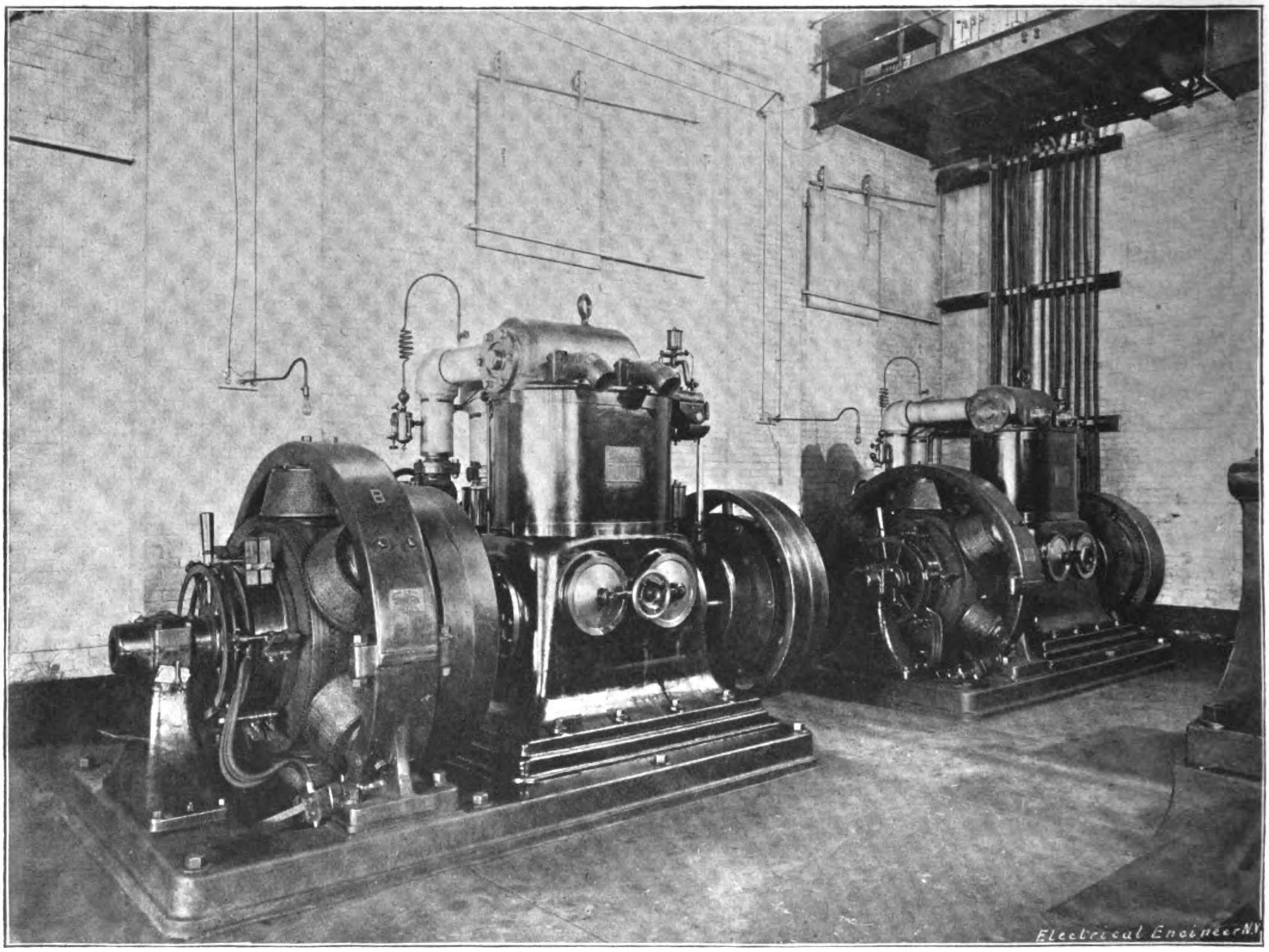
CONDENSING STEAM.

It has been impossible to obtain water for condensing in any location in the city which is otherwise suitable for an electric power plant. The company is about to install a cooling tower system in connection with surface condensers, capacity being provided in the towers to cool a sufficient volume of water to condense all the exhaust steam and maintain a vacuum.

ELECTRICAL GENERATORS.

The large alternating current generators in this station were built by the General Electric Company, as already stated. They were designed by the engineers of the General Electric Company after specifications, dimensions and sketches prepared by the writer. At the time of their construction they were the largest alternating current generators in dimensions ever built, and the largest in output, with the exception of the generators at Niagara Falls, which, however, run at a several times higher rate of speed. Their capacity, when operated single phase, is 1,000 k. w.

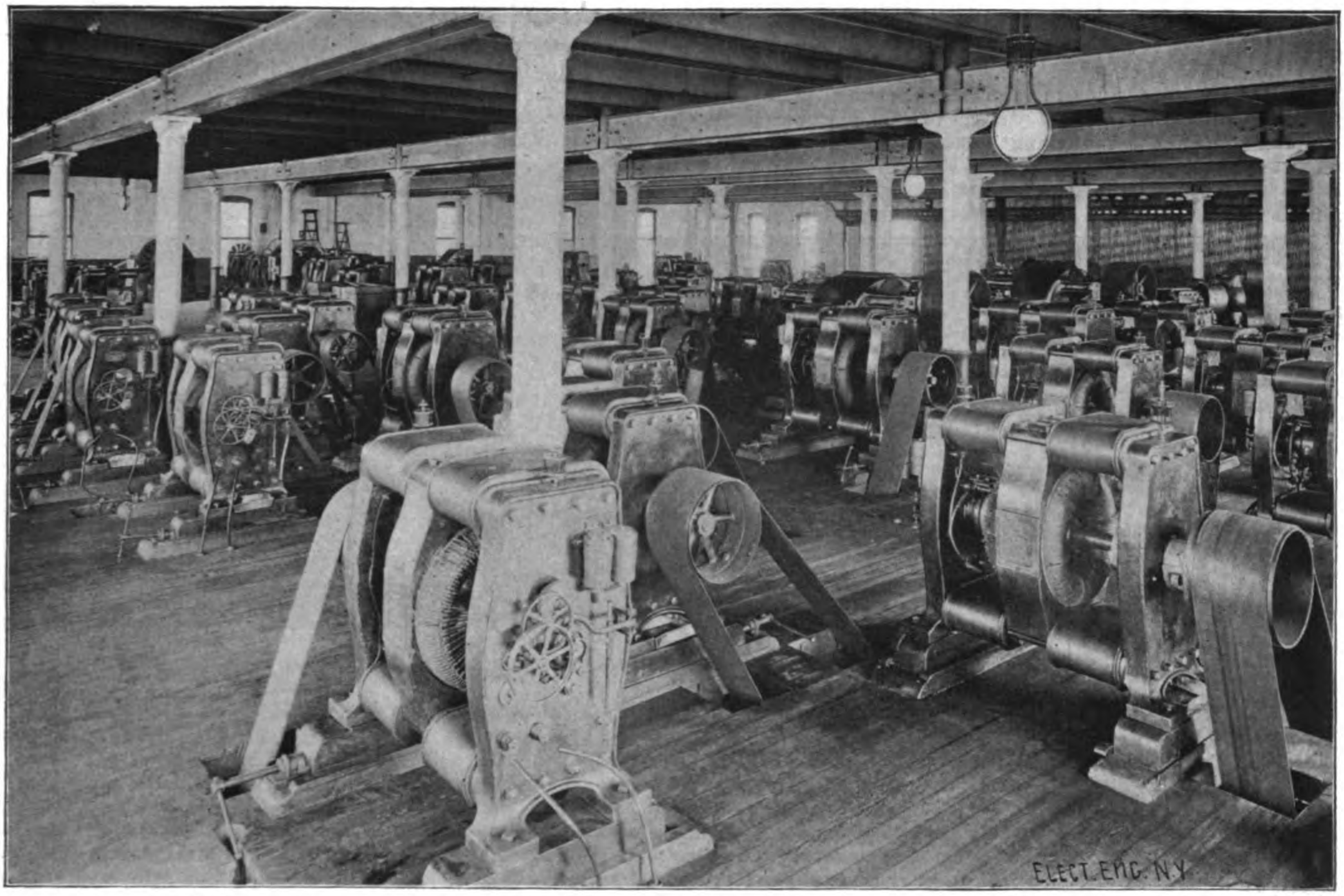
In addition to the single phase winding, another winding is provided in which current is generated differing in phase 90 degrees from the main winding. This quarter phase winding can be so connected as to enable the generators to be operated on the so-called monocyclic system, or on a three-wire single phase system. The generators are now operated at 1,200 volts on single phase only, as the company has adopted the single phase system as most suitable for its general distribution of current for light and power.



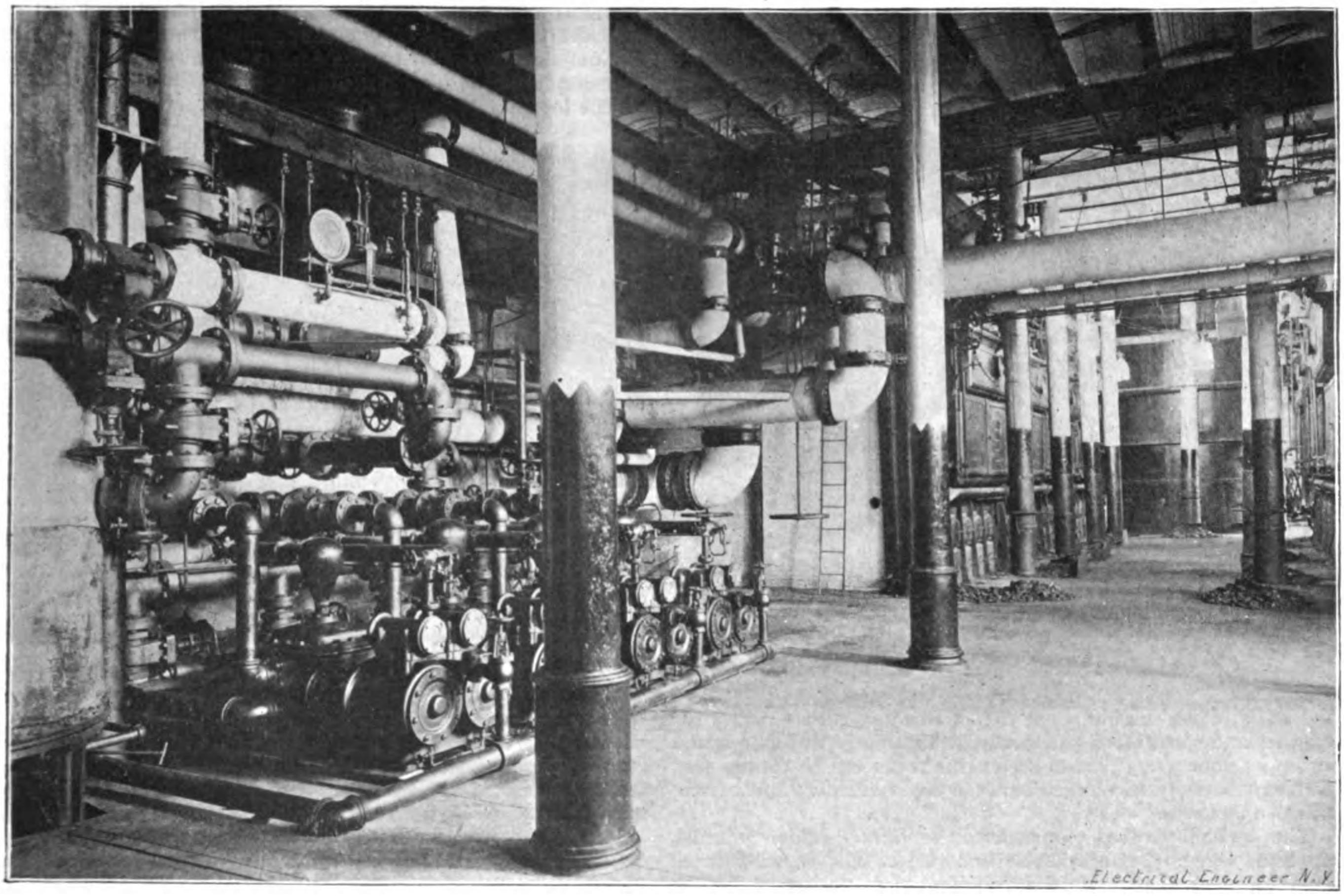
DUPLICATE EXCITER UNITS, STATION "B," MISSOURI-EDISON ELECTRIC CO., ST. LOUIS.

The armatures of these generators are constructed without polar projections, the copper bars forming the winding being embedded in slots as in the modern type of railway generator. They are 16 feet in diameter and have a weight of 100,000 pounds each. There are 80 field poles and the shaft is 22 inches in diameter, this enormous mass being provided to take the place of the usual fly wheel and to give the engines a very uniform angular velocity. A large margin for overloading was allowed in the design of these machines, and they are frequently made to carry for hours at a time a load of 1,200 k. w. They are so massive that even with this load the rise in temperature is almost inappreciable. The frequency adopted by the company for its entire system is 60 cycles, and the armatures revolve at 90 revolutions per minute.

Located near these generators are two 100 k. w. exciter generators, directly connected to compound engines. These exciter generators are of the usual General Electric type of multipolar



STATION "B."—VIEW OF THIRD FLOOR SHOWING WOOD SERIES ARC LIGHT DYNAMOS.

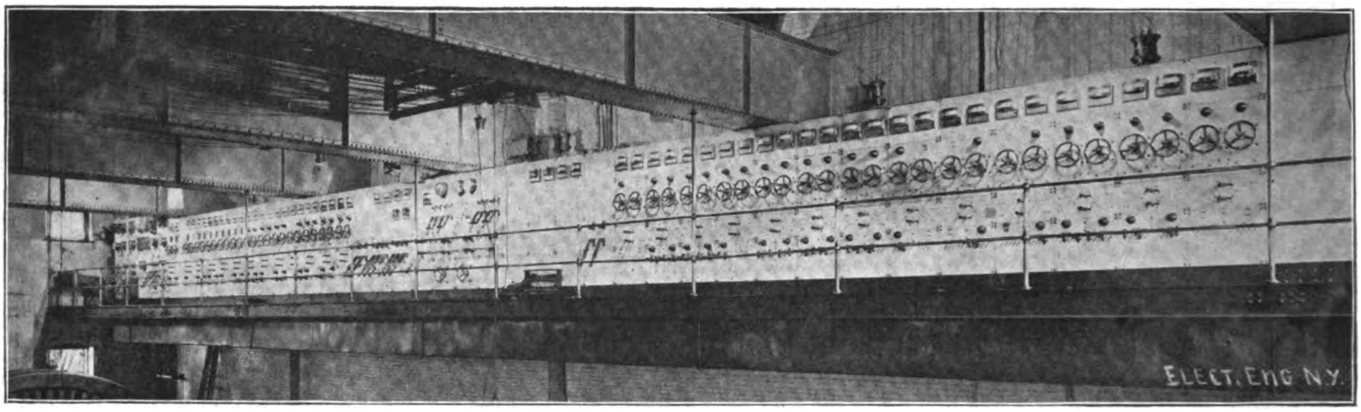


VIEW IN BOILER ROOM, STATION "B," MISSOURI-EDISON ELECTRIC CO.

direct current dynamos and deliver current at a pressure of 125 volts. Each one is capable of generating current for the fields of four 1,000 k. w. alternators.

The 500 k. w. 500-volt generator is of the most recent General Electric pattern. The total weight of this machine is 76,000 pounds, the armature weighing 32,000 pounds. The shaft is 18 inches in diameter.

On the third floor of this station, as already stated, are lo- exciters, and stretching away on either side are the feeder panels containing the necessary switching, regulating devices and instruments for each feeder. Beyond these feeder panels, at one end of the board, are located the switches, devices and instruments necessary for controlling all the 500-volt generators and feeders. Each alternating current feeder takes up a space on the switchboard panels one foot in width and six and one-half feet in height.

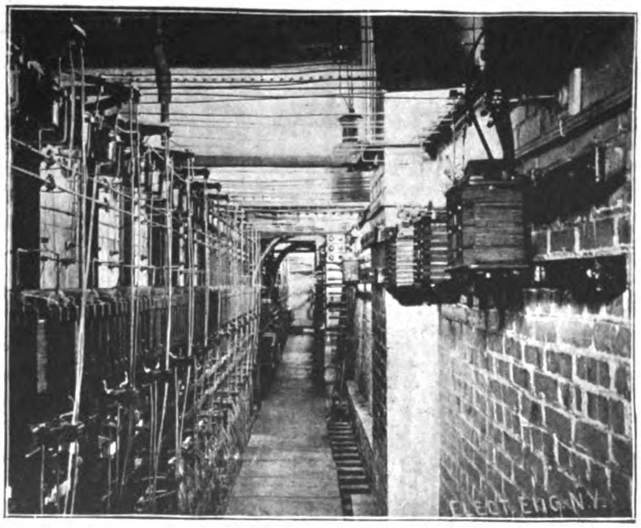


MAIN SWITCHBOARD, STATION "B," MISSOURI-EDISON ELECTRIC CO.

cated a large number of series arc light machines. These dynamos are of the well-known Wood type, manufactured by the Fort Wayne Electric Company, and are of 60 and 80 lights capacity. They have all given excellent service in the eight years during which they have been in daily operation, but the company's business has increased at a such a rate that some method of operating arc lamps on larger generating units was found imperative. The series arc lamps operated by these generators are, therefore, being rapidly replaced with alternating current lamps, operated on the general system from the large generators. The small arc light machines are, therefore, being gradually thrown out of service.

SWITCHBOARD.

As in station "A," the main switchboard is one of the most interesting features of this station, and is so located along one of



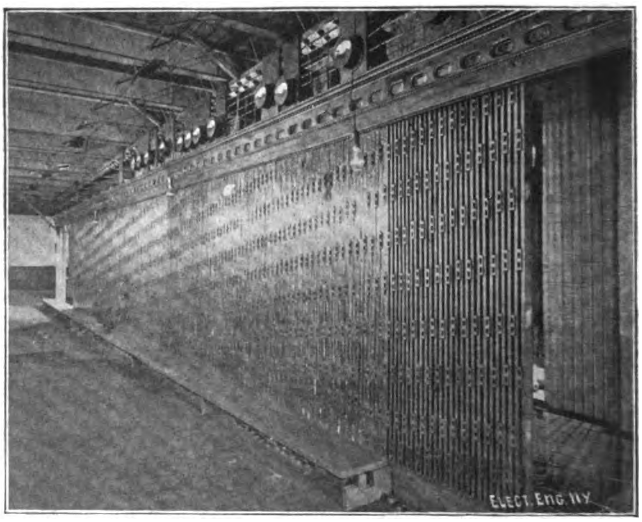
MAIN SWITCHBOARD, STATION "B," REAR VIEW.

the walls of the engine room that it forms a gallery above the engines and generators and occupies absolutely no floor space. From its floor every part of the engine room can be readily seen and signals easily exchanged between engine tenders and switchboard operatives.

The switchboard is constructed of white Italian marble, mounted in panels on an iron framework. The flooring is all made of black slate, as in the switchboard at station "A." The central part of the board is occupied by switches, regulating devices and instruments for the alternating current generators and

A large proportion of these feeders is used for operating alternating current arc lamps for city street lighting. The system devised for this purpose is one which has never been used before commercially, and will be described in detail further on. It necessitates the use of a 40 k. w. step-up transformer, a regulator, a switch and an ammeter for each feeder. The transformers used in connection with these feeders are of a regulating type, built by the Wagner Electric Manufacturing Company, and are hung from the "I" beams supporting the switchboard floor. The feeder regulators are controlled by means of hand wheels on the front of the switchboard and the current used is indicated by an ammeter of the standard horizontal scale illuminated dial type, manufactured by the Wagner Company. The switches and fuse cut-out devices are of special construction, designed to prevent any arcing of the high potential currents.

The location of the step-up transformers and the large amount

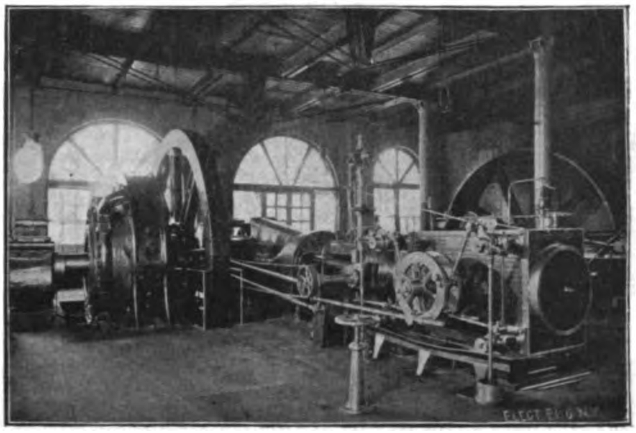


OLD SERIES ARC LIGHT SWITCHBOARD, STATION "B."

of energy transformed by them in a very limited space rendered it desirable to provide better means of ventilation than the natural air circulation afforded. For this purpose an air blast system was devised and constructed, by means of which a low pressure blast of air is directed through the spaces between the coils of each transformer. This is accomplished by a large air pipe two feet square, hung below the switchboard floor directly in front of the line of transformers. Openings are cut in this pipe opposite each transformer and air is supplied by a 72-inch Sturtevant blower, also hung under the switchboard floor against

the wall at one end. This blower is driven by a 15 h. p. single phase alternating current motor. The entire switchboard and all the devices used thereon was built by the Wagner Electric Manufacturing Company.

On the floor above there still remains the greater portion of the old series arc light switchboard, installed when the station was originally built. This is still used in connection with those series arc dynamos which remain in use.

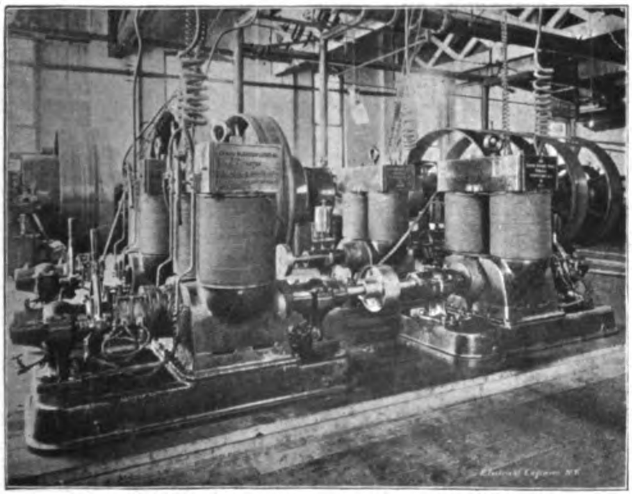


500 K. W., 500 VOLT GENERAL ELECTRIC POWER GENERATOR, AND 750 H. P. HAMILTON-CORLISS ENGINE, STATION "B."

The greater part of the current generated at this station, outside of that used for arc lighting, is delivered to station "A," 5,000 feet distant, through tie lines of large carrying capacity. This current is then distributed from station "A."

STATION "C."

This station was until recently operated by the St. Louis Electric Light and Power Company, the Missouri-Edison Electric Company taking control of it in February last. The arc light and alternating current machinery was at once removed and the station converted into a distributing point for a portion of the 500-volt power system. The equipment now consists of six 125 h. p. tubular boilers; two 300 h. p. Russell engines and three 150 h. p. Russell engines; two 80 k. w. Edison bipolar 250-volt generators, one 110 k. w. 500-volt multipolar generator, built by the Eddy Electric Manufacturing Company, and four 30 k. w. Edison bipolar 250-volt generators. All of the machinery in this station is used as a relay or reserve, in case of accident or repairs to machinery in the other stations.

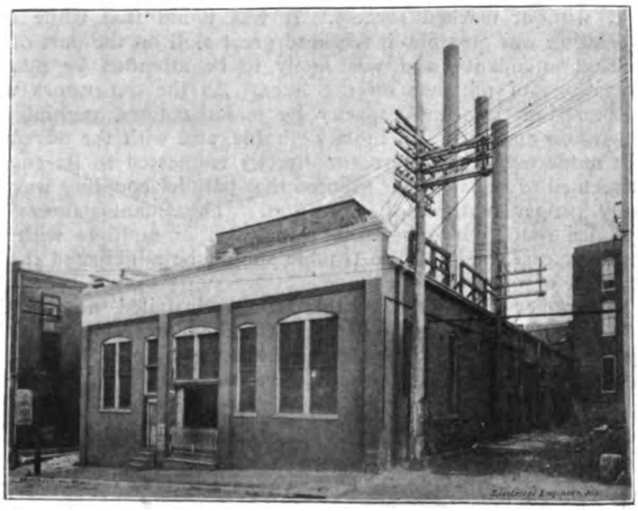


ROTARY EQUALIZERS FOR 500-250 VOLT, 3-WIRE POWER SYSTEM, STATION "C."

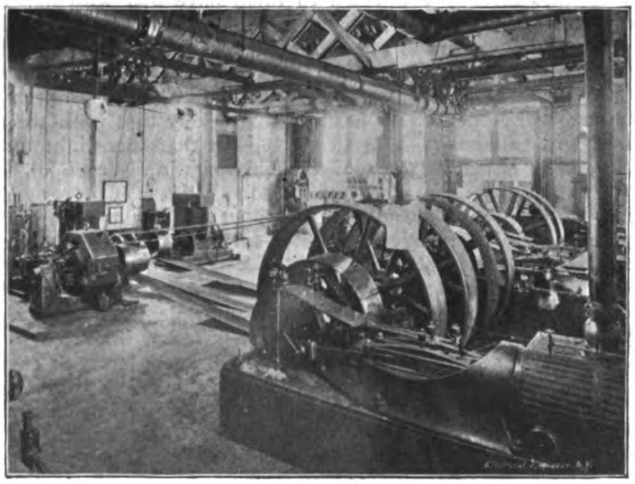
The St. Louis Electric Light and Power Company operated motors on both the 250-volt and 500-volt systems. The systems were, however, kept entirely separate. The two systems are now combined, and the 250-volt distribution carried out by the adoption of the Edison three-wire system applied to the 500-volt lines. The 250-volt generators are connected, two in series, with a middle connection to the neutral bus-bar, and can, therefore, be used for either 250-volt service or 500-volt service. The entire 250-volt system is usually operated by means of the 500-volt generators alone, two sets of rotary equalizers located at station "C" serving to balance the two sides of the 250-volt system very perfectly.

ROTARY EQUALIZERS.

Each set of rotary equalizers consists of two 30 k. w. Edison bipolar 250-volt generators with their armature shafts directly coupled together. They are connected to the switchboard and thence to the system in exactly the same manner as two generators on the three-wire system. To start them, one is used as a motor with the necessary starting resistance switched in series with the armature. In case the load becomes heavier on one side of the three-wire system than on the other the generator on the lightly loaded side becomes a motor and drives the other machine as a generator to supply the current for the difference in load. The equalization of pressure is accomplished so perfectly that the maximum difference of voltage on the two sides of the system at the switchboard is less than 1 per cent. To prevent fluctuations in the field strength of the equalizers the field of each equalizer is connected across the terminals of the opposite one. This equalizer system is not at all new, but seems to have rarely been a success where heretofore tried. This company, however, has never had the slightest trouble in any way with the equalizers or the manner in which they have accomplished their work, although they are old types of machines and designed for a different purpose.



EXTERIOR OF STATION "C."



PORTION OF ENGINE ROOM, STATION "C."

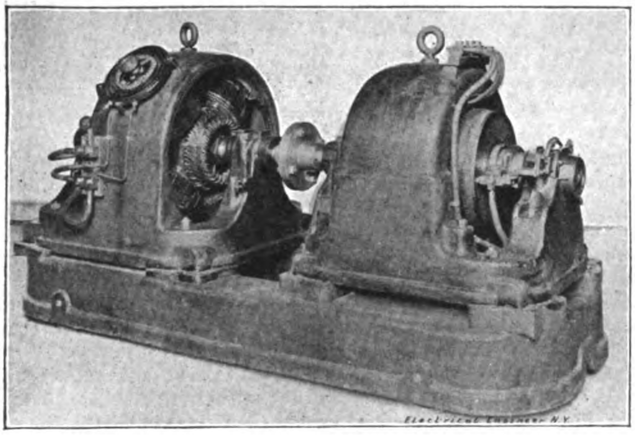
ALTERNATING CURRENT GENERATORS OPERATING IN MULTIPLE.

It has been the usual practice until quite recently in all American alternating current central stations, to operate the

generators independently, switching devices being provided to change feeders at will from one generator to another, so that with changes in load the grouping of the feeders on the generators could be changed as found necessary. In many European stations, more especially in Germany, alternating current generators have for years been operated in multiple arc. The advantages in multiple operation are too obvious to require discussion.

In this country numerous attempts were made to operate alternating current generators, of the earlier types, in multiple arc, without marked success. It was found that while such operation was possible, it required great skill on the part of the station attendants, and was likely to be attended by marked variations of pressure on the lines. As the generators were increased in size and capacity by manufacturers, multiple arc operation appeared still more desirable, and with the advent of the modern type of alternator directly connected to its engine, it seemed to be taken for granted that parallel coupling was the only proper method of operation. The manufacturers all claimed that their generators would run in multiple with the greatest ease, and that no trouble should be anticipated in this method of operation.

A number of water power plants were installed, notably that at Niagara, in which no difficulty was encountered in operating generators in this way, but success has not been marked where engines were used to drive the generators; in fact, almost all



15 K. W. ROTARY TRANSFORMER, SINGLE PHASE A. C. MOTOR AND D. C. GENERATOR.

attempts made to operate the generators in parallel when driven by engines directly connected to them have met with absolute failure.

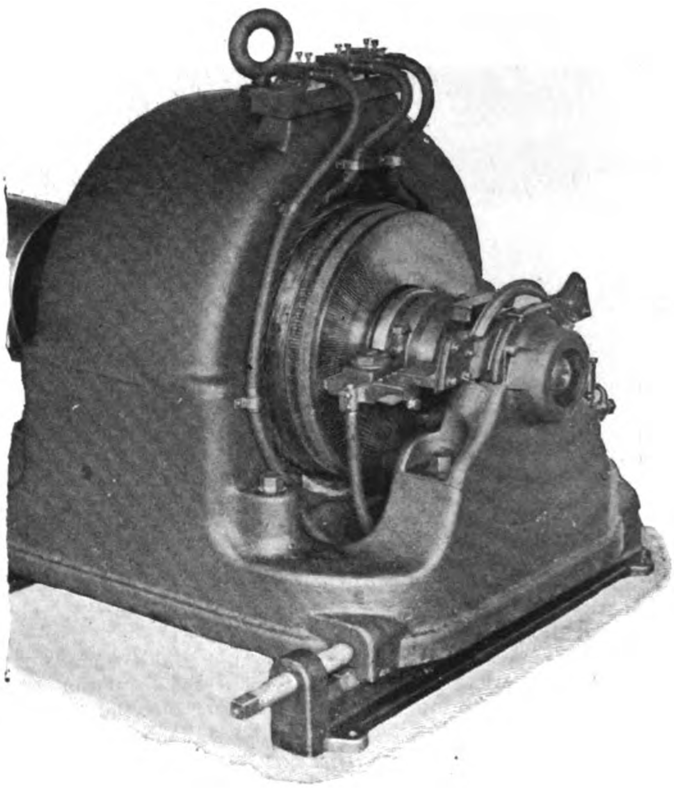
The manufacturers at once took the position that the engines were to blame and that the parallel coupling of alternators was no longer an electrical problem, but a matter of the proper regulation of the engine. It is more than likely that both the engines and generators were to blame, but that the slight modifications in either might render such operation successful. Be that as it may, the Missouri-Edison Electric Company has been able to overcome all difficulties in this connection and is operating its large direct connected alternating current generators regularly in multiple arc.

No difficulty whatever is experienced in operating a generator driven by a double crank engine in multiple with one driven by a single crank engine, although it is found desirable to so couple the generators that the crank of the single crank engine is in step with one of the cranks of the double crank engine.

The early efforts of the engineers of this company were not attended with any better success in this connection than that experienced at other stations, and it was only after a very thorough study of the subject and slight modifications of both engines and generators, that success was achieved.

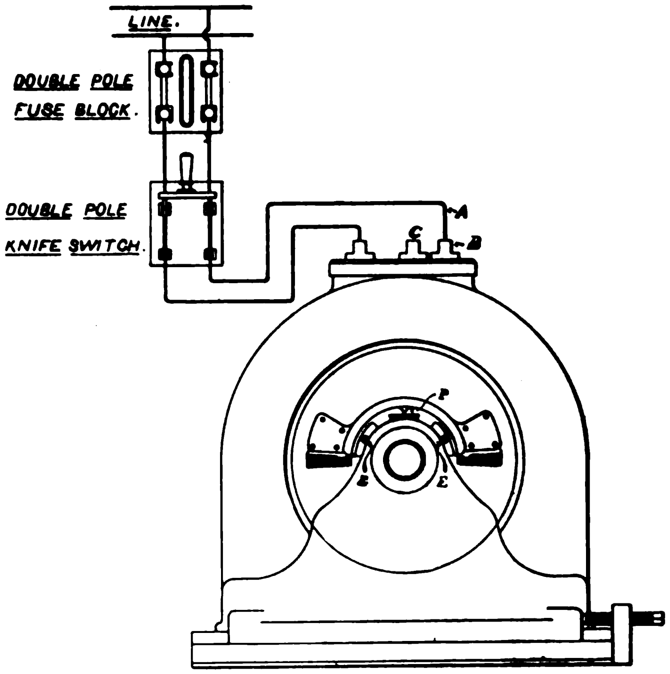
ALTERNATING CURRENT ARC LIGHTING.

It seems to be universally conceded that the enclosed long burning arc lamp is destined to replace all the old forms of arc lamps for commercial lighting. This type of lamp is now made for alternating currents, as well as for direct currents and about equally good results are now secured. The objectionable noise inherent in the alternating current arc, is, practically, entirely subdued in this form of lamp. It has been quite conclusively proved to the writer that the same amount of light for a given number of watts can be secured from a good, enclosed, alternating arc lamp, as from the same type of direct



15 H. P. WAGNER SINGLE PHASE A. C. MOTOR.

current lamp. While it is true that the alternating arc itself is less efficient than the direct current arc, the large percentage of energy wasted in the resistance which must be placed in series with the direct current arc, can almost all be utilized in the alternating current arc. The increased efficiency of resist-



15 H. P. WAGNER SINGLE PHASE A. C. MOTOR—DIAGRAM OF CONNECTIONS.

ance devices attained in the alternating current lamp thus fully compensates for the lower efficiency of the arc itself.

This company is now very rapidly replacing its direct current series arc lamps with the enclosed long burning alternating

MAP OF UNDERGROUND CONDUITS AND CONDUCTORS, MISSOURI-EDISON ELECTRIC CO., ST. LOUIS, MO.

arcs, those at present in use being manufactured by the General Electric Company.

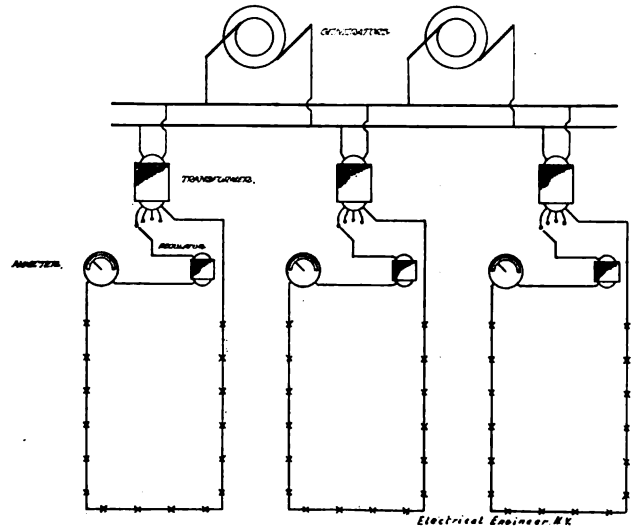
The company long ago appreciated the great advantage to be secured in the economy of operation, and in the saving in investment for relay or spare machinery, by furnishing current for all purposes from one type of generator. This could be readily accomplished with the exception of arc lamps for street lighting over very large districts, and for the operation of motors. The engineers of the company, therefore, devoted their attention largely to these two classes of service and the development of devices and methods by which they could be furnished from the general alternating current system. The results desired have been achieved in the most satisfactory manner.

A system for operating arc lamps in series by alternating current was devised and perfected by the writer, and after a few months' trial with an experimental circuit, it was found perfectly feasible to operate the existing series arc lamp circuits, with the same lamps slightly remodeled, from a step-up transformer for each circuit connected to the general alternating current supply system.

These step-up transformers were designed so that they could be readily regulated to furnish current for from one to eighty arc lamps in series. The system was finally adopted and the company now has 2,300 of these arc lamps in regular operation in this way. The circuits are each provided at the station with the regulating step-up transformer referred to, having a maximum capacity of 4,000 volts and ten amperes, and the feeders to these transformers are treated on the switchboard the same as the feeders for incandescent lighting. The location and disposition of the transformers and regulating devices on the switchboard, have all been described above in connection

with the switchboard at Station "B." It is not unusual for one alternating current generator to carry 2,000 of these lamps.

The lighting is satisfactory to the city and the lamps give better service than when before operated on direct current. There has been a very marked saving in fuel and attendance, and the indicated horse power per arc lamp is considerably less than with the direct current lamps. There is no other station in



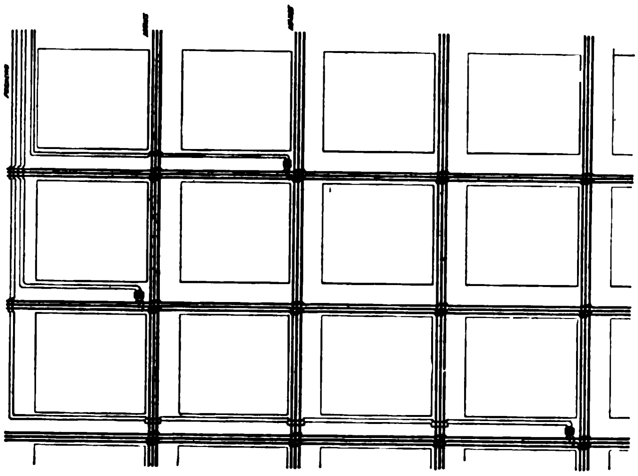
ALTERNATING CURRENT ARC LIGHTING SYSTEM OF DISTRIBUTION.

existence where arc lighting is done in this way, and the system stands as a very pronounced and most successful example of the flexibility and adaptability of the alternating current.

ALTERNATING CURRENT MOTORS.

For several years this company has been experimenting with different forms of motors suitable for operation on the alternating current system. The supposed impossibility of successfully operating motors on this system was one of the chief arguments against its use which were brought forward in the early days of central station practice. Within the last few years the use of current for power has increased very rapidly in the large cities, and the demand for a good alternating current motor became imperative.

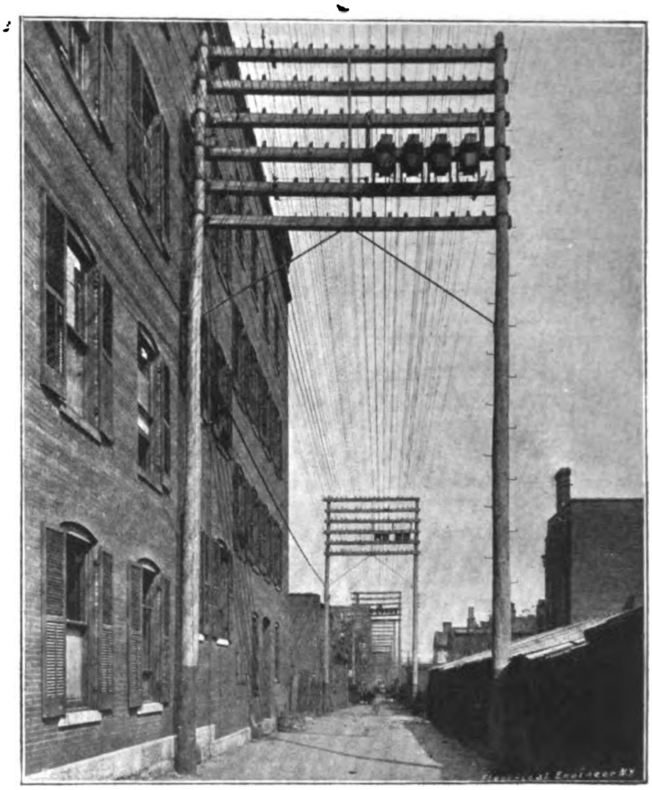
Motors for operation on the two-phase and three-phase alternating current systems have been so perfected that they are



GENERAL SYSTEM OF DISTRIBUTION.—HIGH POTENTIAL FEEDERS AND 3-WIRE LOW POTENTIAL MAINS.

equal in almost every point to direct current motors, and even superior in many ways. The complication, however, of the two-phase and three-phase systems when adopted for general distribution where lighting is the most important factor, and the impossibility of securing as good regulation as with the single-phase system, were so apparent to this company, and were such serious objections to the use of either of these two systems, that it was determined to make every possible effort to secure a good single-phase motor. This they have succeeded in doing, and the single-phase alternating current motors now manufactured by the Wagner Electric Manufacturing Company are being used very extensively on the company's circuits. It is the intention within the next six months to replace the entire 250 volt power service, comprising over 1,000 horse power in motors, by alternating current. Where the alternating current motors have been put in they have given better satisfaction to the customers than the old direct current motors. They require less care in starting, less attention while running, and slightly exceed the direct current motors in efficiency. The current is sold for them entirely on a meter basis.

In some cases for special uses, direct current is desired, and where it is necessary to supply such demand, the company installs a motor generator of the capacity required. The motor generator consists of a single-phase alternating current motor directly coupled to a direct current generator. The potential of the direct current generator can be controlled at will by a field rheostat, and the regulation of the service is therefore entirely under the control of the customer. Apparatus of this



AN EXAMPLE OF POLE LINE CONSTRUCTION.

kind has been purchased from the Wagner Electric Manufacturing Company, and is giving perfect satisfaction.

TERRITORY COVERED BY COMPANY'S LINES.

The company's distributing lines cover the greater portion of the city, and supply service to a district about ten miles long and six miles wide, not including several suburban districts located at a greater distance. The distributing mains run along over five hundred miles of streets. The greater portion of this system is overhead and carried by pole lines, although the company is now engaged in placing its wires underground at a very rapid rate.

Under existing ordinances, all wires must be placed under ground in the most congested portion of the city, comprising a little less than two square miles. In this district the company has its mains under about 30 miles of streets. By comparison with other cities, it will be seen that this company supplies a greater territory probably than that at present attempted by any company elsewhere.

SYSTEM OF DISTRIBUTION.

The general distribution for light and power done by this company, is accomplished by means of an alternating current single-phase system. A complete system of feeders and mains

is used throughout. In a large portion of the city, both feeders and mains are operated at 1,100 volts pressure, carried directly to the customer's premises, where transformers are located to change the potential to 110 volts. In the more thickly settled districts, however, the distribution is accomplished almost entirely at low pressure on the Edison three wire system at 220 volts. In the underground distribution, high potential is used only on the feeders, the entire system of mains being designed

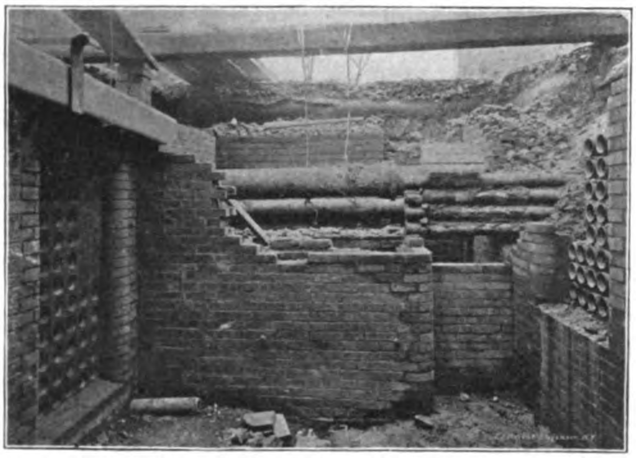
EDISON TUBING LAID ON DUCTS.

for 220 volts three wire. This portion of the system is almost identical in detail with that used by the large stations operating the Edison three-wire direct current system. The usual form of Edison tubing consisting of iron pipe enclosing three copper rods separated by an insulating compound, is used very extensively. The system of mains forms a complete network passing along and connecting almost every street.

At street intersections, junction boxes are located in manholes. These junction boxes contain fuses which will disconnect from the system any block in which a serious defect or

UNDERGROUND CONDUIT CONSTRUCTION.—A FEEDER LINE.

short circuit occurs in the cables or tubing. Any block may also be cut out at will by the same means. Located at the various centres of distribution or feeder terminals, are transformers each of 110 k. w. capacity. These transformers are placed in large manholes, and their primary coils are connected directly to the ends of the feeders, one feeder supplying current to only one transformer, and each feeder being entirely independent of any other. No primary fuses or cut-outs are used in connection with these transformers, as the feeder fuse at the station serves every purpose. The three wire secondaries of each transformer are brought to terminals in a junction box, also located in the manhole. From the bus-bars in the same junction box, pressure wires are run back to the station for each feeder. It will be seen that in this way the transformer is practically made a part of the feeder, and that its drop in potential with load can be considered as part of the feeder drop. The most perfect regulation can be secured and maintained by this system, and

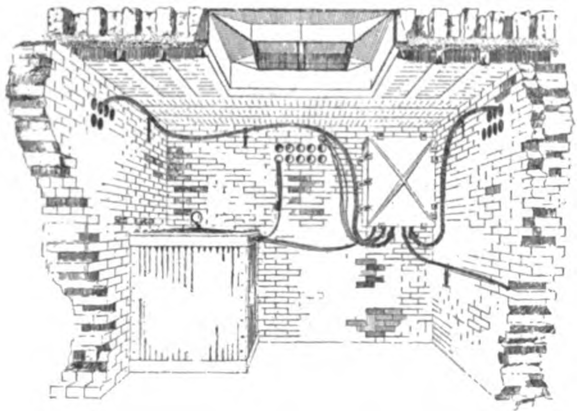


UNDERGROUND CONDUIT CONSTRUCTION SHOWING PORTION OF MANHOLE AND CEMENT-LINED PIPE CONDUIT.

transformers of a higher average efficiency can be designed than any heretofore used.

The average load on the company's lines is about 20 per cent. of the maximum load, and the transformers are designed for the highest efficiency at this load. The transformers used by the company for this purpose are made by the Wagner Electric Manufacturing Company and the Westinghouse Electric and Manufacturing Company, each having supplied a number of these transformers built to the specifications and dimensions of the company's engineers. The specifications call for an efficiency of slightly under 98 per cent. at one-quarter load.

This system of distribution is believed to be the most perfect of any alternating current system in use, and is installed here for the first time. The economy of distribution is very much higher than anything heretofore attained with alternating current, and slightly exceeds that of the best Edison direct



MANHOLE WITH TRANSFORMER AND JUNCTION BOX.

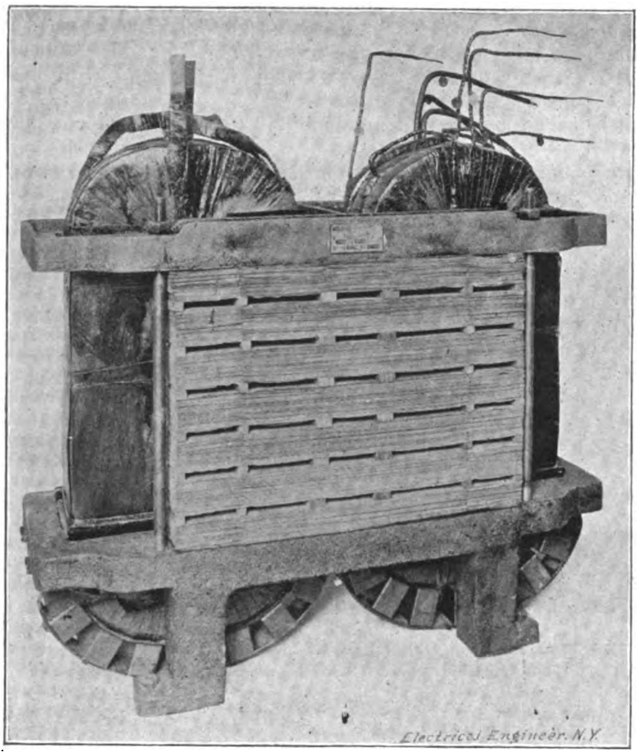
current stations. With an average load of 20 per cent. the distribution efficiency of the entire underground system from the generators to the lamps is 95 per cent.

UNDERGROUND CONDUITS AND CABLES.

For many years the company has appreciated the advantages of having its wires underground in the most thickly settled portions of the city, but owing to numerous complications which arose in the attempts to secure proper legislation for the control of underground conduits, the company until

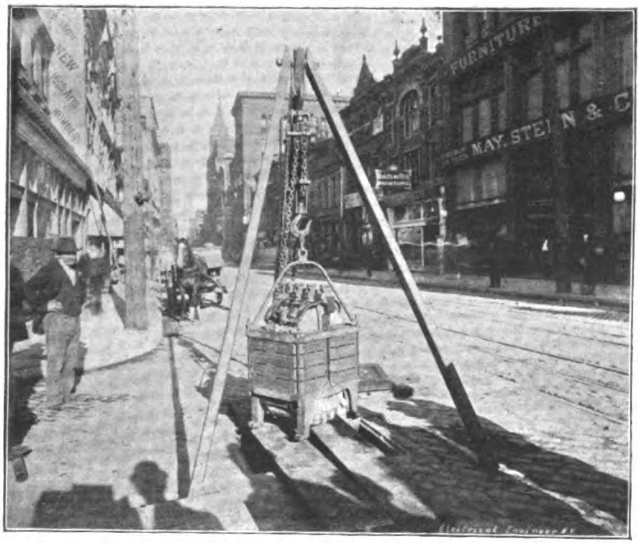
less than two years ago was compelled to place most of its wires overhead.

In April, 1897, the company began conduit construction on a large scale, and having investigated thoroughly the different types of conduit and ducts, contracted with the National Con-



80 ARC LIGHT, 40 K. W., CONSTANT CURRENT TRANSFORMER, FOR TRANSFORMING FROM CONSTANT POTENTIAL TO CONSTANT CURRENT.

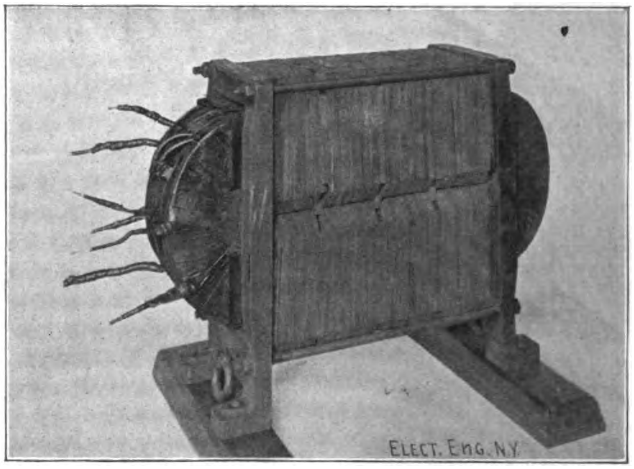
duit Company of St. Louis, to lay about 800,000 feet of cement lined iron pipe. The installation and construction of this conduit system is now completed. The system consists, on most streets, of a multiple duct conduit for both feeders and mains. At every street intersection, a manhole is located, the sizes of these manholes varying from five feet square to eight feet square, the minimum depth being six feet six inches in the clear. With but few exceptions, the manhole covers are all



100 K. W. TRANSFORMER READY TO LOWER INTO MANHOLE.

provided with large slots for ventilation, and nearly every manhole is well drained to the sewer system.

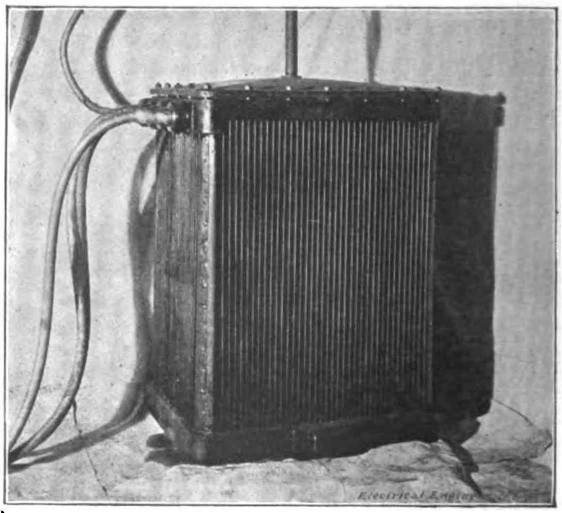
At intervals of from 50 to 75 feet, along every street, are located service boxes 3 feet square, and of the necessary depth to admit the top layer or row of ducts in the conduit. These service boxes are covered by watertight iron covers and provide means for connection with buildings along every street at every alternate building line, so that each customer can be independently connected to the distribution cables. The upper ducts which open into these service boxes are utilized for cables for distributing mains, the lower ducts being reserved for feeders and tie mains. On many streets the usual form of Edison three-wire tubing is also used in connection with the main sys-



80-ARC LIGHT TRANSFORMER.

tem, and on the streets in the retail shop districts the Edison tubing is laid on each side of the street to avoid frequent crossings of the entire width of the street for service connections.

The size of the conductors used for feeders is 150,000 circular mils, and all feeder cables consist of two of these conductors insulated with rubber compound and enclosed in one lead sheath surrounding both wires. This type of cable is usually called "twin conductor." The twin conductor feeder cable was purchased from the Safety Insulated Wire and Cable Company of New York City. The sizes of the conductors used for distributing mains, vary from 100,000 circular mils to 300,000 circular mils. Almost all of these main cables are rubber insulated and were furnished by the General Electric Company. The three conductors are made into one cable which is also covered with lead. The service cables are all of the three-wire type, and are most of them insulated with paper, and lead covered. For 500 volt direct current power service, twin cables are used for mains, a portion being covered with paper insulation and some with rubber insulation, and all being lead covered. They were

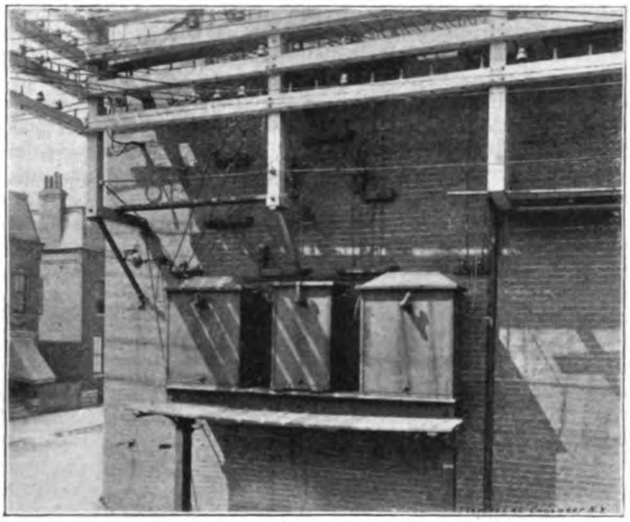


110 K. W. WAGNER TRANSFORMER FOR USE IN MANHOLES.

furnished by the General Electric Company, the National Conduit and Cable Company, and the Safety Insulated Wire and Cable Company.

The junction boxes used in manholes are of the four-way

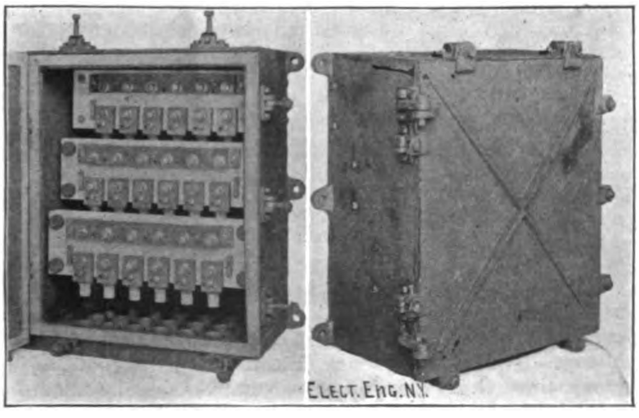
and six-way three-wire type. They consist of large cast-iron boxes with hinged and bolted covers, which can be so closed as to be watertight. Inside are mounted three heavy bus-bars on thick marble slabs. On these marble slabs are also placed, at a suitable distance from the bus-bars, terminals for each cable. Between these cable terminals and the bus-bars, copper fuses are inserted. The boxes are so designed as to secure the greatest distance possible with the limited space between the opposite poles, and to provide for the ready removal of any cable without interfering with any other or danger from short circuiting. These junction boxes are a modification of the Tailleur box used by some of the Edison direct current companies, and were manufactured by the Wagner Electric Manufacturing Company.



STEP-UP TRANSFORMER ON WALL.

TRANSFORMERS.

All of the lighting done by this company, is, of course, on the transformer system, and the total capacity of the transformers employed is somewhat in excess of the station generating capacity and somewhat less than the total number of lamps connected. Over a large portion of the system the usual form of transformer is used. These are of the most modern standard types manufactured by the Wagner Electric Manufacturing Company, the Westinghouse Electric and Manufacturing Company, and the General Electric Company. For long distance transmission to suburban districts, step-up transformers are used at the station to raise the potential to 5,000 volts. Similar transformers are used at the further terminals of these lines, reducing to 1,100 volts again. The step-up transformers most generally employed are of 100 k. w. capacity, placed in large iron boxes, in which the transformers are surrounded by oil for better cooling and insulation.



THREE-WIRE JUNCTION BOX USED IN MANHOLES.—OPEN AND CLOSED.

In addition to these transformers are the large transformers used for underground distribution, which have already been mentioned. The Westinghouse Electric and Manufacturing Company have designed and constructed eight of these special transformers for the Missouri Edison Electric Company. These are uniformly of a capacity of 110 k. w. To economize space in the manholes where it is necessary to locate these transformers, it was desirable to make them as compact and as small in dimensions as possible. By a most careful consideration of design it was found possible to get them within dimensions as follows: Height, 42 inches; width, 34 inches; depth, 26 inches. To provide the greatest possible radiating surface, the sides of the boxes are deeply corrugated, most of them being made of a special form of corrugated sheet iron firmly attached to castings at top and bottom. The specifications for these transformers limited the iron loss to 250 watts, and the copper loss to 3,200 watts. Both of these items are somewhat lower in the transformers as built. At average loads the rise in temperature of these transformers will be exceedingly small, and at full capacity will be well within safe limits during the comparatively short periods per day, when they will be called upon for full supply.

RECAPITULATION OF GENERATING APPARATUS.

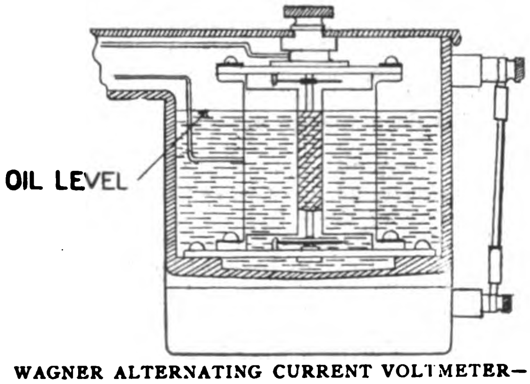
STATION "A."

Vertical compound engines, Lake Erie, 6,500 h. p.; vertical compound engines, Westinghouse, 3,060 h. p.; direct connected A. C. generators, Westinghouse, 3,000 k. w.; direct connected D. C. 124 volt generators, Westinghouse, 150 k. w.; direct connected D. C. 125 volt generators, General Electric, 100 k. w.; belted A. C. generators, Westinghouse, 1,080 k. w.; belted D. C. 500 volt generators, 400 k. w. Total engine capacity, 7,560 h. p. Total generator capacity, 4,730 k. w.

WAGNER ALTERNATING CURRENT VOLTMETER.

STATION "B."

Horizontal comp. Corliss engines, Hamilton, 1,500 h. p.; horizontal single Corliss engines, Hamilton, 4,800 h. p.; vertical compound engines, Westinghouse, 240 h. p.; direct connected A. C. generators, General Electric, 2,000 k. w.; direct connected D. C. 500 volt generators, General Electric, 500 k. w.; direct connected D. C. 125 volt generators, General Electric, 200 k. w.; belted D. C. 500 volt generators, 380 k. w.; belted D. C. series arc lt. dynamos, Wood, 1,350 k. w. Total engine capacity, 6,540 h. p. Total generator capacity, 4,430 k. w.



WAGNER ALTERNATING CURRENT VOLTMETER—DIAGRAM OF MECHANISM.

STATION "C."

Horizontal simple engines, 1,100 h. p.; belted generators, 250 and 500 volts D. C., 390 k. w. Combined total capacity: Engines, 15,200 h. p.; generators, 9,550 k. w.

LIGHTING AND POWER WORK OF THE COMPANY.

Inventive genius is constantly devising new applications for electricity, and the number of uses to which the current is now put in the various industries in a large city is almost legion.

The fact that this company employs alternating current in the largest portion of its distributing system seems to have had no effect to limit the number of applications, and practically all of the work is being accomplished in St. Louis with alternating current that is done in other large cities with direct current. In addition to the alternating current system the company has, as already described, a comprehensive system of 500 volts direct current distribution.

The advantages of the alternating current for long distance transmission of current for distribution have been utilized in reaching the principal residence and suburban districts. It is safe to say, therefore, that no other lighting company in existence can boast of as many residence lights. The total number of residence lamps connected to the company's supply lines is at present 75,000.

The commercial lighting of the company includes the lighting of stores, offices, factories and hotels. This portion of the company's business now aggregates about 93,000 lamps.

In addition to these two classes of lighting there are 8,350 incandescent lamps used in lighting city buildings and portions of streets and alleys. This lighting is done under a contract with the city and covers a period of ten years ending January 1, 1900.

The arc lighting furnished by the company is principally included in the two classes, commercial lighting and city lighting. For commercial lighting there are now about 2,100 lamps in use. Under contract with the city the company also furnishes about 2,500 arc lamps of 2,000 c. p. each for street lighting. This contract was for a period of ten years and expires on January 1, 1900.

For power work an ever increasing amount of current is being demanded, the greatest growth of the company's business during the last year having been in this department. The number of uses to which electric power is applied is only limited by the number of applications found for motive power of all classes in the mechanic arts. Many of these are familiar to everyone, and the field is too great to attempt to describe in detail. The company is at present able to furnish either alternating current, 250 volt direct current or 500 volt direct current for power use.

One of the latest and most important applications of electric power is that of elevator service, both freight and passenger. The electric motor lends itself admirably to this class of work, and it is predicted by many that hydraulic and steam elevators will soon be a thing of the past. The company is prepared to operate either of the latter kinds of elevators, however, by the use of motors applied indirectly to the elevator mechanism.

For hydraulic elevators the motors are required to drive power pumps which displace the steam pumps ordinarily used. In one instance the company is operating a steam elevator by means of compressed air supplied by a compressor driven by an alternating current single-phase motor. This installation is unique and interesting, and promises to open up a field for service, which could not otherwise be secured, owing to the great cost of changing the steam apparatus for the direct connected electric.

At this time of year the most prominent application of electricity is for driving ventilating fans and small desk and ceiling fans. The number of these fans on the company's circuits reaches up into the thousands and is not included in the figure of total horse power of motors operated by the company. The small fans are so easily moved about and connected to any lamp socket that it is impossible for the company to keep track of them, or any record of their number.

STATION MANAGEMENT, USE OF METERS, ETC.

The large extent and many ramifications of the company's business renders its separation into many departments most necessary. Under the General Superintendent of the company are six Superintendents of Operating Departments, each department having its own special duties and being held responsible for such by the General Superintendent.

Each station has its corps of operatives under the direction of several foremen or chiefs of divisions. Over these are placed a Superintendent of Steam Department, and a Superintendent of Electrical Apparatus. The overhead system of lines forms an important department, separate from the department of underground lines.

In addition to the different department divisions, each station forms practically a department by itself, and all accounts are kept separate for each station, and each station's record for economy of operation is accessible at any time. One very important department has in charge the testing, repairing and maintenance of all meters and instruments.

Practically the entire output of the company is paid for on a meter basis. With but few exceptions, each customer has a meter where the wires enter his premises, and bills are rendered in accordance with the meter record. The entire amount of current delivered is recorded in this way, but the actual output of current from each station is also recorded by wattmeters, through which the current from each generator must pass. On the record of these station output meters is based the determinations of cost per unit of each item entering into the company's operating expense.

The meters used are those manufactured by the Westinghouse Electric and Manufacturing Company and the General Electric Company. Most of the meters used for alternating current are of the induction type and have been shown to be most accurate and durable in continuous service. The company has on its lines over 10,000 of these meters, and the entire maintenance and care of this number requires the time of only four young men.

The difference between the records of the station output meters and the meters showing delivery of current to the customers' premises represents the losses in distribution and in the meters themselves, due to their occasional failure to register the entire amount of current passing, when this is extremely small. The average losses shown by this difference are quite appreciable in amount, but appear exceptionally small when compared with those recorded by other companies.

THE COMPANY'S OFFICERS—CONCLUSION.

It is impossible in the scope of this article to go into the many smaller details of the construction of the plants and distributing systems of the company and its methods of managing and operating its business. From what has been said, however, some idea can be gained of the unparalleled extent of the distribution system, of the many problems which have been solved by the company's engineers, and of the new and original systems and appliances developed.

The success of the company is largely due to the excellent personnel of the organization. The officers of the company have had large experience in the management of large interests, and the Directors are most representative of the city's large commercial institutions.

The officers are: President, S. M. Dodd; Vice-President, James Campbell; Secretary, Sherman B. Pike; Treasurer, J. G. Kelly; General Superintendent, Herbert A. Wagner. Board of Directors: S. M. Dodd, James Campbell, J. C. Van Blarcom, James W. Bell, Thomas H. West, Edwards Whitaker and R. C. Kerens.

Electrical Apparatus for Spain.

Even Spain shares in the general rush for American electrical machinery. The Westinghouse Electric and Manufacturing Company, through its London representatives, has installed one of its 135 k. w. single-phase separately excited alternators, belted to a Westinghouse engine, for the Malaga Electricity Company, of Malaga, Spain. The decay of Spain's power might be traced largely to the absence of engineering ability. She cannot build her own machinery, and in most cases she is unable to operate it when it is built.

THE SELECTMEN OF MIDDLETOWN, CONN., have granted permission to the Middletown Street Railway Co. to extend its tracks from Pameacha Park to Crystal Lake Park, a distance of four miles. Work will be begun at once.

Storage Battery of the Chicago Edison Co.

IN the admirable lecture delivered by Mr. Samuel Insull before the electrical engineering students of Purdue University at Lafayette, Ind., that gentleman dwelt at considerable length on the function and value of the storage battery in electric central stations. That he has the courage of his convictions is evident from the fact that the Chicago Edison Company has just completed the installation of what is probably the largest storage battery plant in the world, situated in the basement of the Edison building on Adams street, Chicago.

The causes which led up to the installation of this battery are worth dwelling upon as paralleling the experience of many another company. The business growth of the Chicago Edison Company had been such during the past year that the down-town winter maximum increased from 36,000 amperes in 1896 to 44,000 in 1897, and, assuming the continuance of the present growth, the winter maximum of 1898 on the down-town system will be in the neighborhood of 55,000 amperes. In fact, a point had been reached where new investment in machinery or battery had to be made. The peak of the load occurs in winter time at about 4:45 p. m., and is about 12,000 amperes in height, with an average duration varying from three-fourths to one and one-quarter hours.

The conditions of a battery installation from the point of investment were very favorable, since the current is carried from the Harrison street station to 139 Adams street, the site of the original plant, over a trunk line 3,500 feet in length, and then distributed. The old Adams street site was, therefore, a very favorable point for a battery installation, since a large trunk line investment was avoided. Moreover, the centre of load of the system has been gradually moving farther away from 139 Adams street, so that for good regulation at time of maximum load in winter, with feeders varying from 800 feet to 3,000 feet in length, either a booster system or a large outlay in copper had to be considered. The battery filled the conditions, being designed to discharge on two voltages, 125 volts to accommodate short feeders, and 140 volts for certain long feeders, although it is equipped with a third-end cell switch, so that still another voltage of discharge can be obtained should the future necessitate it.

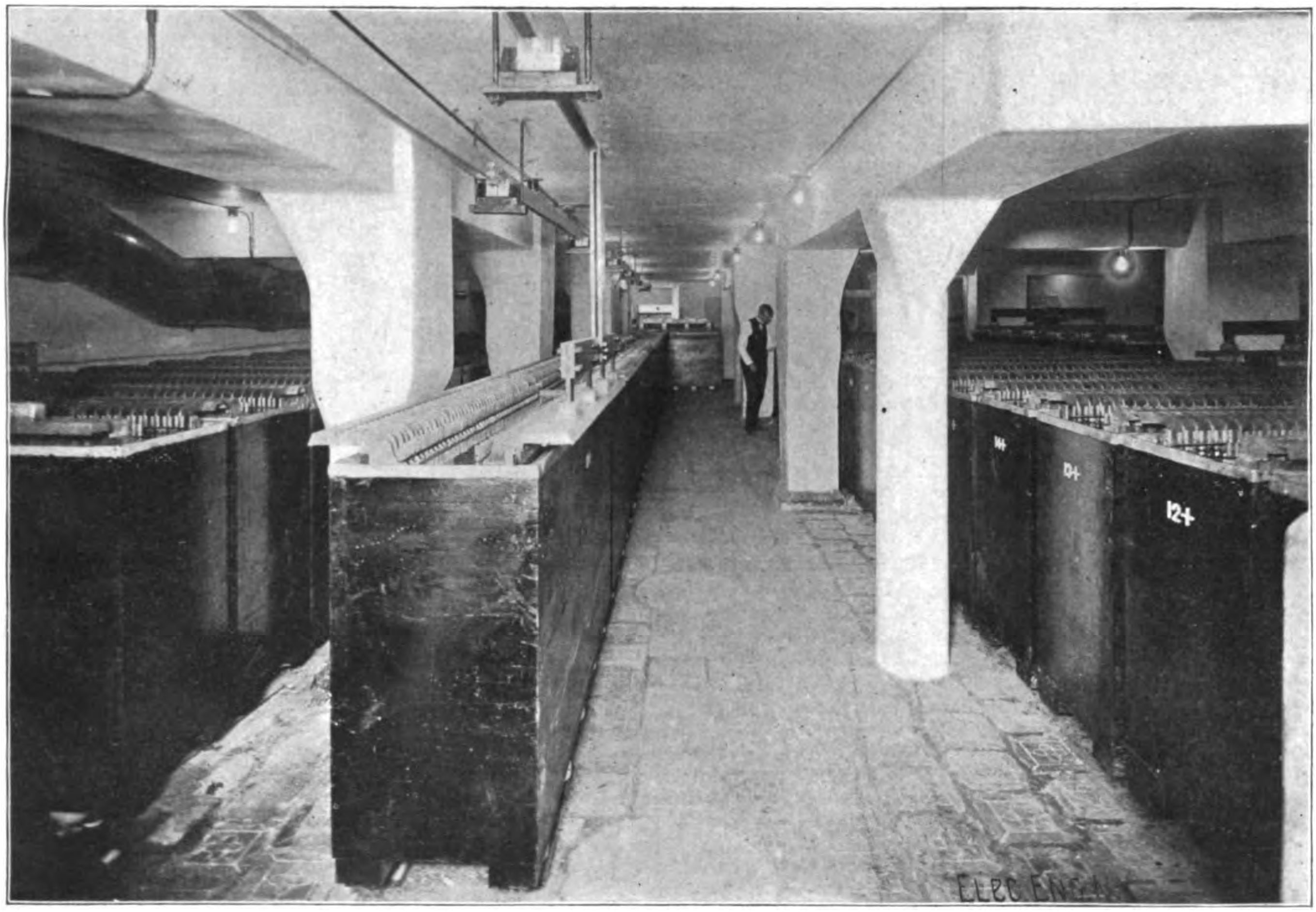
LOCATION.

The battery is located in the basement of the office building of the company at 139 Adams street. Precautions were taken to see if the footings of the columns supporting the floors above would be sufficient to sustain the weight of a duplicate installation in the future. New footings were necessary and the building was temporarily shored up. The question of permanency in every detail was the first consideration, as the size of the installation and the limited area and head room made alterations in the future out of the question.

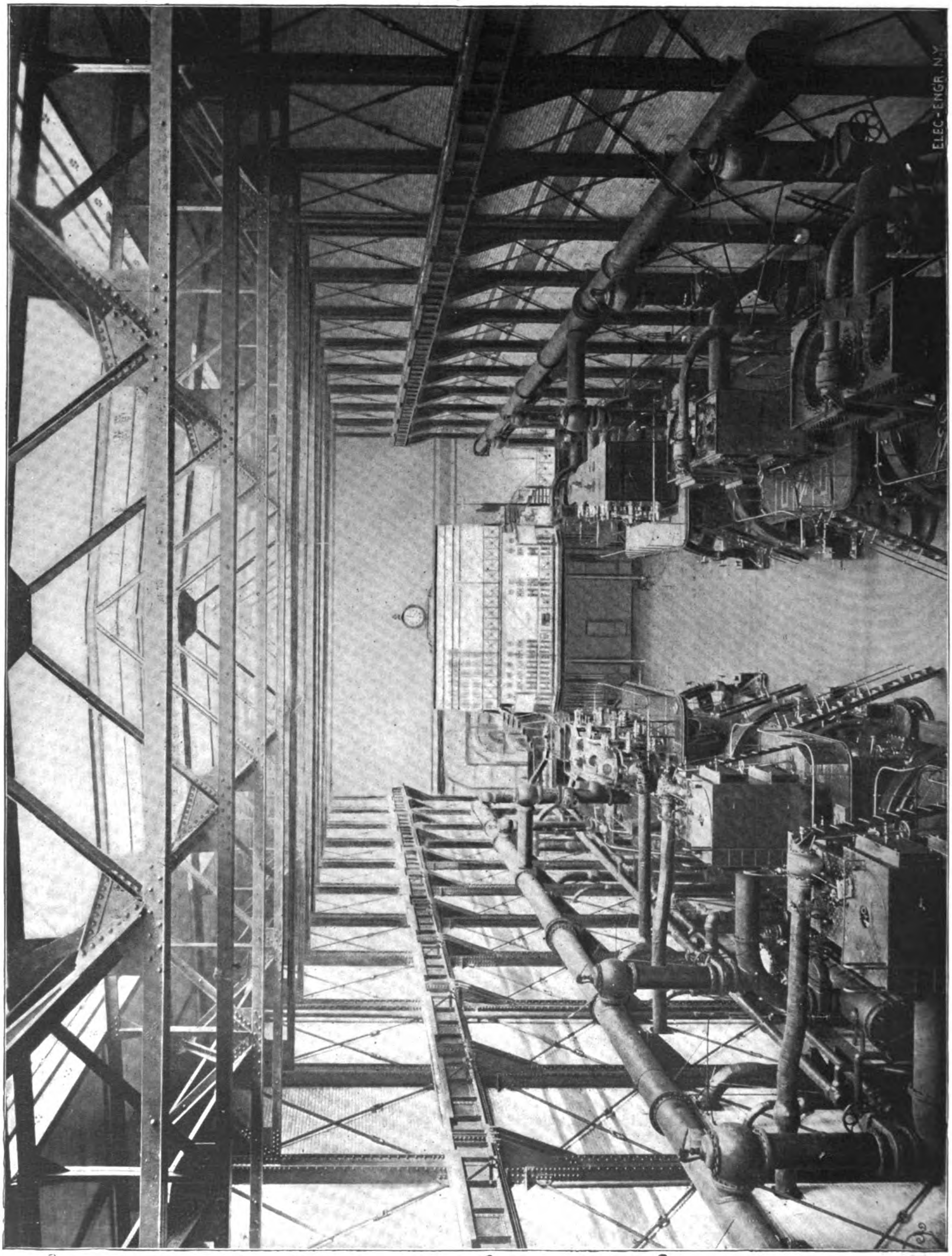
The matter of sub-drainage, surface drainage, supports for the cells against ceiling, as the building is not piled and on soft ground, the floor and protection of the columns and iron beams supporting the upper floors of the building and the ventilation were most carefully considered. A sub-drainage system of 3-inch tile pipes laid in concrete was installed and surface drainage lead pipe laid in sand draining several lead-lined sumpts, and both draining into a large sumpt at the extreme south end of the room, which is emptied by a lead-lined centrifugal pump and discharged to the sewer. To prevent settling, five 4-inch I-beams were laid crosswise under the cells, the space between being filled with concrete. Over this a few courses of tarred felt were laid.

The floor is of vitrified shale tile, 10x10x2 inches, laid in a mixture of 70 per cent. of asphalt to 30 per cent. of coal tar. The bottom of the columns is encased in lead. The columns were carefully cleaned, then treated with a galvanic varnish and afterwards encased in wire lathing and covered with an alkaline cement plaster and then covered with a coating of anti-acid paint. All of the walls and ceilings are treated with the same plaster and are rendered impervious to acid fumes.

For ventilation, two ducts on opposite sides were run the en-



STORAGE BATTERY PLANT OF CHICAGO EDISON COMPANY.

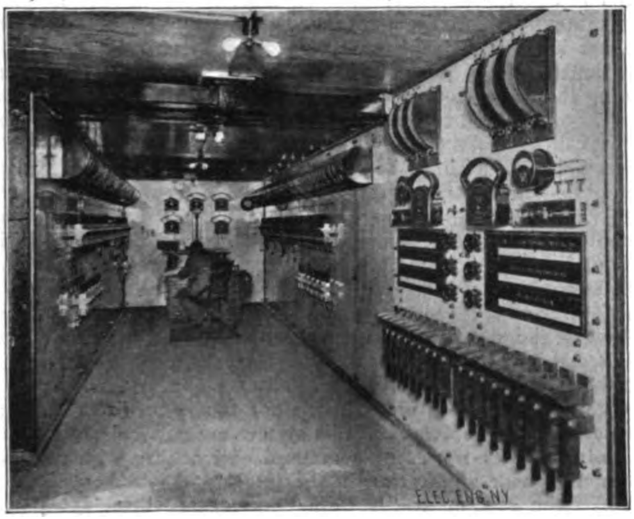


INTERIOR OF THE DYNAMO AND ENGINE ROOM SEEN FROM ELECTRIC CRANE HARRISON STREET STATION, CHICAGO EDISON CO.
(See Elec. Engr. of Jan. 25, 1895.)

tire length of the room, one for blowing in fresh air, the other for exhausting. This affords several cross currents of air and effectually removes the gases, which are conveyed to the roof and blown to the outer air.

THE BATTERY.

The battery has a capacity of 22,400 ampere hours at an eight-hour rate, and will be able to discharge 11,000 amperes for about one and one-quarter hours. It consists of 166 chloride accumulator cells (60 of which are end cells), 83 on each side of the three-wire system. This large number of end cells is required to meet the wide conditions of pressure. The battery is called upon to deliver 140 volts on each side at the end of discharge, and in case of an emergency to deliver current at a maximum of 120 volts on each side when fully charged. Each cell contains 87



SWITCHING ROOM, CHICAGO EDISON CO.'S STORAGE BATTERY PLANT.

plates (known as type "H"), whose dimensions are 15½x32 inches. The positives are of the standard Manchester type. Each tank is 21½ inches wide by 79¾ inches long by 43⅞ inches high and weighs 6,200 pounds. The total weight of the battery, exclusive of conductors, is 1,029,200 pounds. The tanks are constructed of 2-inch ash, lined with 5-pound sheet lead. They are each supported on ten double petticoated insulators resting on tiles laid on the acid-proof floor.

CONDUCTORS.

The end cells are connected to the end cell switches by lead-covered copper bars 6x½ inches, supported by insulators resting on iron girders strung between the columns of the building. The main connections of the battery consist of two copper conductors, giving a sectional area of six square inches. The lead coating of the copper is a special feature, which renders the copper impervious to the action of the acid and gases.

END CELL SWITCHES.

There are three end cell switches on each side of the system. These switches have 30 points and are capable of carrying 2,750 amperes each. The connection between the 30 contacts and the bus-bar of the switch is made by a laminated copper brush traveling on a screw operated by ½ h. p. series motor. These motors are put into operation by push buttons on the controlling switchboard, but are stopped automatically when the brush reaches the mid-point on the contact block by an automatic device, which breaks the motor circuit and short circuits the armature. The method insures the positive action of the end-cell switch without requiring attention of the switchboard operator. These switches are provided with a hand wheel for hand operation if desired. The gear wheels are arranged so that the three switches can be geared together and operated as one switch, thus giving a capacity of 8,250 amperes on each side of the system.

CONTROLLING BOARD.

The controlling board is connected to the bus-bars of the end cell switches by 12 cables of 1,500,000 cir. mils each. On the controlling board there are three single-pole switches for each end cell switch, enabling it to be connected to either the mains, auxiliary or charging busses. Each end cell switch has an indicator on the controlling panel operated mechanically by light shafting and gearing, which shows the operator the exact position of the traveling brush on the end cell switch at all times. On each panel of the board there is a 30-point voltmeter switch connected to a low-reading voltmeter, which enables the operator to take the voltage of the end cell switches.

One of the important features in connection with this battery installation is the method of charging without the use of boosters, which are ordinarily employed in most battery installations. The method of charging in the Chicago Edison battery installation is to operate a pair of 200 k. w. machines in the Harrison street station at about 180 volts, which is the voltage required for charging, and send the current over a portion of trunk line from Harrison street to the battery station at Adams street. The voltage regulation of the dynamos is effected by an automatic control of the field resistance by means of small motors, which are controlled by the operator in the battery station at Adams street, small lead-covered cables being run from Adams to Harrison street, connecting with the motors controlling the field boxes.

These generators, which are used for charging, are not generators specially made for the purpose, but are the same ones which at other periods of the day are used to feed into the main bus-bar of the station, thus saving an investment of about $15,000 in boosters, as well as providing a system of charging, which is very much more economical than the one in which boosters are employed.

The battery will be kept in circuit at all times during the daytime in summer, "floating" on the circuit, keeping the engines at the Harrison street central station working at their most economical point, the battery being ready at any time to take care of any sudden increase in load which may occur in the system, as well as taking care of the peak in winter time, for which purpose it was primarily purchased. By maintaining the battery on the circuit continually the necessity for regulation of pressure at the central station is very much lessened.

The battery was furnished, as well as the entire installation carried out, by the Electric Storage Battery Company, of Philadelphia.

The Electrical Engineer, it may be added, has from time to time noted the growth of the Chicago Edison Company, including this last development, and it is not now necessary, therefore, to go into all the familiar details again. In its issue of January 23, 1895, The Engineer devoted a score of pages with some thirty fine illustrations to the work of the Chicago Edison Company, and to the article would refer its readers. As a fitting supplement, however, to its article on the storage system, and to give an idea of the huge generating plant which the batteries reinforce, we reproduce herewith the cut giving a view of the interior of the Harrison street station. Our issue of May 26 presented the annual report of the Chicago Edison Company, and we have just printed, as above noted, the lecture by Mr. Samuel Insull, based largely on his work in the management of the Edison central station system and the other plants of the company.

Throwing Out Welsbach Burners.

ABOUT a year ago, it would appear, Welsbach burners were introduced in the Federal Building at Toledo, O., and a saving over electricity of $1,000 a year by the return to gas was expected. But the Welsbachs are now coming out, and the Toledo Consolidated Electric Light Company has the contract for the ensuing year. In the Post Office the effect of the Welsbachs was particularly disagreeable. In the mailing room the burners are said to have raised the temperature several degrees above the ordinary, and the general influence on the workers was bad. Now that the summer is coming on, such ill effects would be accentuated, but the reversion to electricity is made in good time, and the men will not only enjoy a healthy method of illumination but be able to avail themselves of electric motors from the same circuits. There is no question that the Welsbach is an improvement over the ordinary naked gas jet, but when it comes to permanent competition with electricity it is not in the race at all. It is a makeshift that has been chiefly recommended by its alleged superior economy.

BOSTON.—The Boston Electric Light Company, in its annual report shows earnings of 13 per cent. It is paying 6 per cent. The stock is selling at 120.

THE

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Single Phase Alternating Current Work as Exemplified at St. Louis.

FOLLOWING our usual custom of presenting in connection with the annual meeting of the National Electric Light Association some striking feature of central station work, we have on the present occasion gone westward and selected the work carried out in St. Louis. The stations and systems of the Missouri Edison Electric Company deserve more than passing notice for several reasons. We believe that we are not wrong in asserting that the conviction has become firm in the minds of central station managers that so far as transmission of current, as distinguished from local distribution, is concerned, there is only one method now worth discussing, and that is the alternating current. But, on the other hand, it cannot be said that the means and methods by which the alternating current can be applied have yet crystallized into a standard system. By this we mean to say that there is by no means unanimity of opinion as to whether the single, the two-phase or the three-phase system of transmission is best adapted for transmission work within cities. In our issue of January 6, of this year, we described the new system of the Brooklyn Edison Company, in which three-phase current has been employed as a basis, from which all other currents for distribution of whatever kind are derived. In the present issue we present what is without question the highest development thus far reached in single-phase alternating current distribution in the United States, if not in any other country. Mr. Herbert Wagner has for years kept in mind the desirability of utilizing one set of generating machinery for every possible use which could be called for on the consumption circuits, and having started out with the single-phase alternating current he has kept his original object constantly before him. How well this talented young engineer has carried it out will be gathered by a perusal of his timely and valuable contribution to central station literature, which appears in this issue. Mr. Wagner's article embodies a number of fundamental principles, without which alternating working on a thoroughly economical basis cannot be obtained. The first of these which will strike the reader is the fact that the alternating generators are operated in synchronism, as distinct from the old and still very general practice in this country, of operating each machine independently of every other. There is no question that some types of alternators are better adapted to synchronous operation than others, but that all can be so operated is now conceded to be a fact. Perhaps, as Mr. Wagner remarks, it is usually the case that both the dynamos and engines may be a little to blame for non-success in synchronous working. But it only requires perseverance and the application of a little experience to bring about the desired result. In the case of the engine particularly, the application of the Rites regulator seems to have done much towards accomplishing the desired result. Mr. Wagner has also perhaps developed far beyond any other central station manager the application of the single-phase alternating motor to power work, and has shown that this machine, notwithstanding the persistent criticisms brought against it, can, under intelligent management, be made to fulfil the mission which has in the past largely been delegated to the direct current motor. As to the underground distribution system, Mr. Wagner has evidently planned very carefully, and his claim for an efficiency of 95 per cent. between generator and lamps, including the transformer, on a 20 per cent. load, places his system even beyond the best economy attainable with direct current systems.

But what will perhaps be considered the most striking feature exemplified in the work at St. Louis, is the operation of arc lamps in series, with alternating current derived directly from the same generators running the incandescent circuits. It is perhaps in this direction that Mr. Wagner has struck out in the most original way. The use of the constant current alternating transformer with regulator permits of lamps being run in series in exactly the same manner as from the direct current arc machines, but evidently with a far greater economy due to the fact that the load is taken off machines of 1,000 k. w. capacity as compared with the older maximum 100 h. p. direct current arc machines. The details of this system are particularly worthy of study, as they represent a method of working which seems destined to wide application in the future.

While the station at St. Louis represents what is without doubt the highest development of single-phase alternating current work, the direct current for local distribution is still with us, and, if anything, is obtaining a stronger hold than ever before. An exemplification of this fact is the installation of the great storage battery in the Chicago Edison Company. Taking the plants at St. Louis and Chicago side by side, for example, it seems harder than ever to formulate a definite opinion as to the ultimate outcome of the struggle for supremacy which has been waged the past dozen years between the direct current and the alternating current. In fact the situation seems to be that, with intelligent management, either system can be made to give good results; and while there may be slight advantages as to cost and other incidental features on one side, there are on the other hand offsets which counterbalance these advantages. We trust that the topic as exemplified in the two stations above referred to, including that of the new Brooklyn station, may come up for discussion at the convention. Some of the most prominent electricians of the country will be present, and the members will no doubt gather a few grains of experience well worth the trip to Chicago.

The Liquefaction of Hydrogen and Helium.

LINKED together by vast commercial interests as well as by close scientific relations, the sciences of electricity and chemistry have each had a decided claim on the attention of investigators in either field ever since Galvani and Volta were engaged in their celebrated controversy over the origin of the electric current in a voltaic cell. The analysis of water by means of the electric current and the investigations of Faraday, which led him to the discovery of the laws of electrolysis, giving us a clearer conception of electrical phenomena, as well as the later commercial production of calcium carbide, disinfectants, and other products by means of the electric current, including the reduction of metals from their ores, have all demonstrated the great value of electro-chemistry and its revolutionizing influence on the arts. It is but natural then that the electrical engineer and investigator of to-day should be keenly interested in the labors of his fellow scientist, the chemist, knowing as he does,

that every discovery in chemistry can be advantageously applied to some engineering process or aid in elucidating the mysteries of the electric current. However long these may remain hidden from the human understanding, a problem equally obscure and interesting is the one of the change of the properties of substances at or near the absolute zero of temperature. That this can only be reached by the liquefaction of gases has been known for a long time, and all but two gases had been liquefied until recently, when, on May 10, Professor Dewar succeeded in liquefying the two remaining gases—hydrogen and helium. This epoch-making discovery, the far-reaching importance of which cannot be overestimated, was communicated by Prof. Dewar to the Royal Society in a most interesting paper. The hydrogen was cooled to — 205° C., and escaping continuously under a pressure of 180 atmospheres from the nozzle of a coil of pipe at the rate of 10 to 15 cubic feet a minute, in a vacuum vessel doubly silvered, and of special construction, surrounded with a space kept below — 200° C. With these arrangements liquid hydrogen began to drop from this vacuum vessel into another, doubly isolated by being enclosed within a third, and in five minutes 20 cubic centimeters of liquid were collected. The hydrogen jet then froze up from the solidification of air in the pipes of the apparatus. The yield of liquid was about 1 per cent. of the gas. In a subsequent experiment five gallons were produced in one hour. In the liquid condition the hydrogen was clear and colorless, showing no absorption spectrum, and the meniscus was as well defined as in the case of liquid air. The liquid in Prof. Dewar's opinion must have a relatively high refractive index and dispersion, and the density must be in excess of the theoretical values, viz., 0.18 to 0.12, deduced respectively from the atomic volume of organic compound and the limiting density found by Amagat for hydrogen gas under infinite compression. The second experiment was with a tube containing helium. The Cracow Academy Bulletin for 1896 contained a paper by Prof. Olszewski, entitled "A Research on the Liquefaction of Helium," in which he stated that, as far as his experiments went, helium remained a permanent gas, and apparently was much more difficult to liquefy than hydrogen. Prof. Dewar, however, suggested and showed that hydrogen and helium had about the same volatility as was the case with oxygen and fluorine. Having a specimen of purified helium, extracted from Bath gas, sealed up in a bulb with a narrow tube attached, he placed the latter in the liquid hydrogen, whereupon a distinct liquid was seen to condense. In conclusion Prof. Dewar pointed out that all known gases had now been condensed into liquids which could be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels, though even so great a man as Clerk-Maxwell had doubts as to the possibility of ever liquefying hydrogen. With liquid hydrogen as the cooling agent a temperature could be reached within 20 or 30° of the zero of absolute temperature, and its use would open up an entirely new field of scientific inquiry.

This great discovery and the production of liquid hydrogen in large quantities will no doubt open up new fields for scientific investigation and aid us in our endeavors to look further into Nature's workshop, to discover the constitution of matter and perhaps the transmutation of metals and the nature of electricity itself.

Our Supplement.

As bearing closely on the subject of the relative advantages of the different systems for city transmission work, we present with this issue a chart carefully worked out by Mr. A. B. Herrick, showing the limits within which the various systems can be profitably employed. With this chart before him, the electrical engineer, knowing the amount of power required to be delivered at a given distance from the station, is enabled to tell almost at a glance what system will prove best adapted to the conditions. The curves on the chart indicate some very interesting relationships between the various systems, and their intelligent study may prevent some serious mistakes on the part of those contemplating extensions of territory.

OBITUARY

Dr. Charles E. Emery.

Charles E. Emery, Ph.D., died at his home in Brooklyn on June 1 of heart failure. He was a consulting engineer of no little repute in this country. He was born in Aurora, N. Y., in 1838. In 1861 he entered the Navy and was appointed third assistant engineer with a post on the warship Richmond. He fought in the battle of Pensacola and accompanied Farragut in the famous series of battles on the Mississippi. His good work during these engagements led to his promotion as second assisting engineer in 1862 when he took part in the blockading of Charleston. After honorable service during the entire war he resigned in 1867 and was appointed consulting engineer in the United States Coast Survey and Revenue Service. In this position Mr. Emery had charge of the construction of war vessels and revenue boats for the Government, until the work was finally put into the hands of a Navy Yard Department. His title of Ph.D. was conferred upon him by the University of New York as an appreciation of his work. He added to this distinction by receiving the Telford prize for the best paper read before the English Civil Engineers in London, some time in the eighties. He was always a prominent member of the American Society of Mechanical Engineers and was president in 1896-7 of the New York Electrical Society, as well as a member of the American Institute of Electrical Engineers. He was a non-resident professor of Cornell University and his lectures on engineering matters have been heard in all the prominent cities of the country. He was also a member of the American Society of Civil Engineers.

As an expert in engineering matters, he has figured in many Brooklyn water litigations, and recently he was interested in the damage cases resulting from the flood in Bound Brook, N. J. He was not only an engineer in theory, but in actual practice and had several patents for important improvements in machinery. He was connected with the New York Steam Company as consulting engineer at the time of his death.

Mr. Emery left a wife and one son. The funeral took place from his residence, Greene avenue, Brooklyn, on Friday.

LITERATURE

HOW TWO BOYS MADE THEIR OWN ELECTRICAL APPARATUS. By Thomas M. St. John. Publisher same. New York. Cloth. Illus. 141 pp. Price, $1.

The author of this book is a teacher and writer of great ingenuity, and we imagine that the effect of such a book as this falling into juvenile hands must be highly stimulating and beneficial. It is full of explicit details and instructions in regard to a great variety of apparatus, and the materials required are all within the compass of very modest pocket money. Moreover, it is systematic and entirely without rhetorical frills, so that the student can go right along without being diverted from good helpful work that will lead him to build useful apparatus and make him understand what he is about. The drawings are plain and excellent. We heartily commend the book.

PERSONAL

COL. C. E. McCLUER, the Richmond, Va., superintendent of the Southern Bell Telephone Company, has resigned and has been succeeded by Mr. Hunt Chipley, of Norfolk, Va.

The First Electrical Wedding.

A very unique and interesting wedding was celebrated at the Electrical Exhibition on Wednesday, June 1, at 9 p. m., when Mr. Charles Sanford Merten and Miss Jennie S. Gilmour, of the Boroughs of Bronx and Queens respectively, were joined in wedlock in the Moore chapel by an assistant of the Rev. Dr. Houghton, of the Church of the Transfiguration. The Mendelssohn and Lohengrin wedding marches were played on an Estey pipe organ run by an electric motor, and later in the evening a phonograph played hymns. The chapel was brilliantly illuminated by Moore tubes and beautifully decorated, and the general effect was as imposing as it was impressive. A very august assemblage was present, and the bride was given away by Mr. C. O. Baker, Jr., the president of the Exhibition, and Mr. Marcus Nathan, the general manager of the Exhibition, was the best man. To make the electrical wedding a complete success and novelty, both bride and bridegroom came to the wedding in electrical carriages from their respective homes.

Armington & Sims Co.'s Exhibit.

THE Armington & Sims Co., of Providence, R. I., builders of the well known automatic cut-off high speed engines, are exhibiting in the generating section a 100 horse power 90 lbs. 275 r. p. m. engine direct connected to a Walker generator. It is one of the 1898 pattern high speed engines which embodies the devices and improvements which long practical

ARMINGTON & SIMS ENGINE DIRECT CONNECTED TO A WALKER GENERATOR.

experience has shown to be essential to the highest efficiency attainable in engines of this character. Most important among these improvements are the self adjusting cylindrical or piston valve, the Rites inertia governor, and the oiling devices. The exacting requirements of electric railway and lighting service have called for engines of massive construction, with the metal properly distributed to insure absolute rigidity throughout. All these requirements will be found to be satisfactorily met in this engine; indeed, they will generally be found to be somewhat heavier than corresponding sizes in the product of other builders.

Onondaga Dynamo and Fischer Engine Exhibit.

ONE of the quietest running units in the generating section is that exhibited by Messrs. Fairchild & Sumner and Porter & Remsen, 39 Cortlandt street, New York. It consists of a 6-pole engine type, 75 kilowatt Onondaga dynamo, direct connected to a Fischer engine. It furnishes a large portion of the light and power for the exhibition. The Onondaga

EXHIBIT OF ONONDAGA DYNAMO AND FISCHER ENGINE—BASEMENT.

dynamo possesses many admirable features. The magnet yoke is made of a special mixture of gray iron and is generous in proportion and neat in design. The magnet cores are made of soft charcoal forged iron, and are cast welded into the magnet yoke, thus doing away with all unnecessary bolted joints. The bearings are self-aligning, self-oiling, and of the ball and socket type. The brush holder is so designed that a uniform bearing is obtained with a minimum pressure, thereby causing a small amount of friction on the commutator, eliminating heat due to this friction; carbon brushes are used. Messrs. Fairchild & Sumner report large sales of the Onondaga machines, a recent installation consisting of two direct connected machines at the New York and Staten Island Electric Co.'s new power house at Livingston, Staten Island, and a large dynamo and several motors to the Atlas Cement Co., of North Hampton, Pa.

The Fischer automatic self-oiling high speed engines are made of either the single or four-valve type, the engine at the exhibition being a 125 horse power, four-valve tandem compound direct connected engine. The main features of the engine are the oiling device and the strength and simplicity of the construction throughout. The oil is contained in a large settling tank around the crank case, the oil passing from this to the main bearings, crank pin, crosshead pin and slide and valve rod slide and pin and thence back to the settling tank, all of the oil not actually lubricating the moving parts being contained in the tank where it cools and settles and again passes through its course. The crank case has a partition keeping it separated from the stuffing box, thus keeping the oil from being thrown against the cylinder-head and the steam and water which may leak through the stuffing from mixing with the oil. The valves are adjusted from the outside, it being unnecessary to remove the valve chest covers or use the indicator after the valves have been set at the shop. There are no keys or screws in the machine which can work loose and cause damage while the engine is running. A "Corliss" card is obtained from the four-valve engine, and on larger sizes a steam consumption equal to that of the best Corliss engine is obtained. The company are prepared to demonstrate these claims by actual tests at their works to anyone interested, and all engines are thoroughly tested under working conditions before leaving the shops. The Fischer Foundry & Machine Co. have a complete modern plant thoroughly equipped for turning out horizontal or vertical engines of either the centre or the side crank types. The success of this company during the forty years they have been in business is a guarantee of the quality and workmanship of the material sent out by them.

Although the engine is practically new in the Eastern market, the number of orders received during the last few months should indicate that success is assured. One of the latest sales is that of a valve direct connected engine to the Union Traction Co., of Philadelphia. The company are represented in New York by Porter & Remsen, 39 Cortlandt street, and they have offices in Philadelphia, Chicago and Boston. The exhibit is in charge of Mr. F. H. Sheppard.

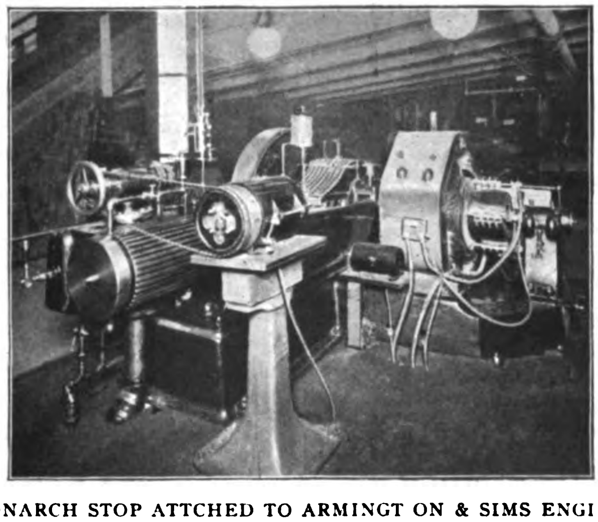
Operative Exhibit of the Monarch Manufacturing Company.

ONE of the most interesting exhibits in the generating section is that of the Monarch Manufacturing Company, 39 Cortlandt street, New York. From this exhibit one can easily understand the working of the well known Monarch engine stop and automatic speed limit, which are shown in actual operation. The Monarch stop can be seen mounted upon one end of a table, while an eight-inch globe valve is shown at the opposite end, connected by sprocket wheels and chain to the stop. This globe valve may represent the throttle valve on an engine's cylinder or a stop valve on a boiler, both being handled alike by the Monarch stop. As a hand wheel is turned to open the valve the two sprocket wheels and chain cause the drum of the stop to revolve around its central shaft, and while thus revolving it winds a flexible wire cord around itself, elevating weights which are connected to the opposite end of this wire cord. When these weights are elevated, it indicates that the valve is completely open, allowing steam to pass through.

A number of electric push buttons are placed in various positions about this booth, and when any one of these is touched a temporary magnet in the engine stop is energized, which attracts an armature and releases the mechanism which holds the weight in the elevated position shown, and the valve is thus closed in three seconds after making the twelve turns which are necessary to send it from a full opening to a complete closure.

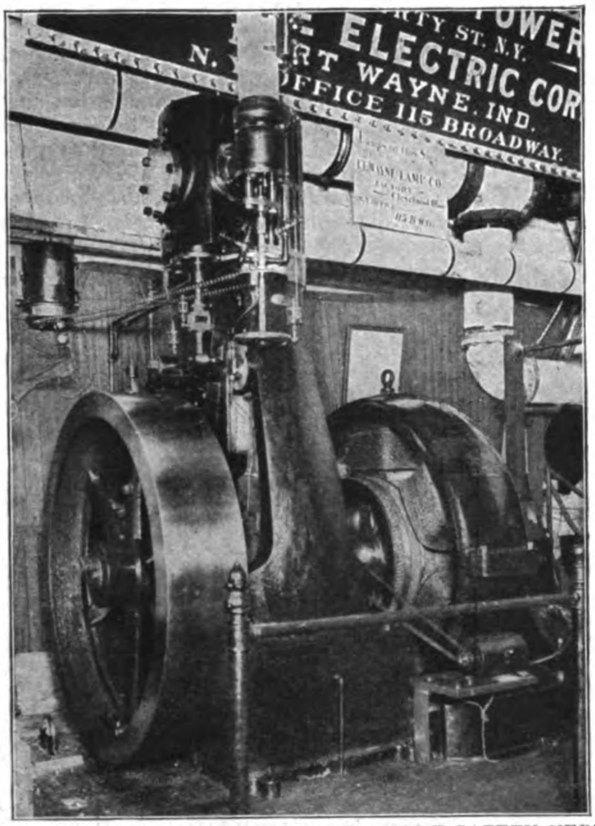
On a front counter at the left one of these engine stops is shown with the cover raised and at the left, inside of this stop, a large air dash-pot or air cushion can be seen. The office of this dash-pot is to arrest the very rapid motion of the closing valve just before it reaches its seat, thus causing it to seat easily but still firmly. If this provision were not made, the seats of the valve would soon be destroyed, as may be easily understood. At the same time that one of these electric push buttons is touched an electric gong at the rear of the booth begins to ring, thus notifying an engineer that his engine or boiler valve is being closed from some distant point, and this bell will continue to ring until either the switch contained in the stop is thrown out, or the stop mechanism is reset ready for the reopening of the valve.

Mounted on a table at the left of the exhibit is shown a Monarch automatic speed limit, while on the front counter at



MONARCH STOP ATTCHED TO ARMINGT ON & SIMS ENGINE.

the left can be seen a second speed limit with its cover raised. In actual service this device is belted directly to the crank shaft of an engine and is thus kept revolving whenever the engine is in operation. By examining its construction it will be found to contain a governor composed of two balls, each one being mounted upon a flexible flat leaf spring. These springs are fastened securely at one end to a collar fixed upon its central shaft, while the opposite ends are connected to a second collar which slides backward and forward upon the shaft, its position being determined by the size of the circle described by the two governor balls. When the speed of this instrument is increased beyond a certain number of revolutions (which correspond to



MONARCH STOP ATTACHED TO NEW YORK SAFETY VERTICAL ENGINE.

the normal speed of the engine) the sliding collar makes a contact with two separated fingers, from which electric wires are run to the stop. As soon as this contact is made the circuit is closed, and the valve is rushed to its seat in precisely the same manner that it is operated when a push button is touched. Thus it will be seen that when the revolutions of the engine exceed a certain predetermined safe speed, its throttle valve is closed almost instantly, thus making a fly wheel accident impossible and also preventing a wholesale blowing of fuses.

In this exhibit a Crocker-Wheeler motor is substituted for the revolving crank shaft of an engine and by means of a rheostat the speed of the motor can be easily varied. When the motor is revolving at a speed that drives the speed limit about 400 revolutions per minute the speed limit does not affect the stop, but as soon as the handle of the rheostat is turned, causing the motor to increase its speed the stop valve is closed immediately, as has just been described.

In order to illustrate the sensitiveness of this instrument a Schaffer & Budenberg tachometer is connected to it and from this tachometer the exact speed at which the speed limit is being operated can be easily read off and by its use it is shown that the excess of even one single revolution above the 400 revolutions (to which speed this instrument is set) will cause it to close the electric circuit and thereby cause the stop to close the valve.

At the rear of this exhibit is shown the Monarch stop controlling an A. & F. Brown friction clutch, which clutch is disengaged instantly by merely touching any one of several push buttons placed about the booth. When a button is touched and the elevated weight allowed to fall, the revolving sprocket wheel draws its encircling chain with the clutch lever attached in the direction necessary to throw out the clutch. The clutch pulley is revolved by a small Crocker-Wheeler motor and when the clutch is thrown in, by moving the lever towards the pulley, the shaft, of course, revolves; and as soon as one of the push buttons is touched the Monarch stop causes the lever to be

pulled away from the clutch pulley and the main shaft ceases to revolve instantly. By this device it can be seen that when the Monarch stop is applied to a clutch, press buttons may be run to various points in a factory, some being placed upon dangerous machines, so that in case any one is caught in a machine belting or shafting they can press the button and stop the machinery instantly.

The illustrations show the application of the Monarch stop and automatic speed limit to the large vertical engine exhibited by the New York Safety Steam Power Company, and to the Woodbury engine exhibited by Messrs. Burhorn & Granger. The apparatus have attracted a great deal of attention and have received many favorable comments from the numerous visiting stationary engineers who can readily appreciate their great advantages. The genial general manager of the company, Mr. Albert A. Cary, was in constant attendance to explain and to answer the numerous questions asked by interested parties.

Exhibit of the Hebrew Technical Institute.

LOCATED on the balcony to the right of the main entrance, is the very handsome and instructive exhibit of the students' work of the Hebrew Technical Institute, which has attracted considerable attention during the past few weeks, not alone on account of the variety of apparatus shown, but also on account of the youth of the boys who designed, constructed

HEBREW TECHNICAL INSTITUTE EXHIBIT.

and used them. The following machines and measuring instruments are exhibited, which give a fair idea of the excellent work done by the pupils of this well known institution: A 1 k. w. Edison bipolar dynamo, two Thomson reflecting galvanometers, a Faraday disc dynamo, four resistance boxes, a large pair of electro-magnets, an astatic and tangent galvanometer, a bichromate battery, a Wheatstone slide wire bridge, frictional electrical machine, four medical coils, etc. The boys designing and constructing this apparatus are between the ages of thirteen and sixteen, and it is clearly seen that the essential fact is impressed upon the student's mind that he must design commercially practical apparatus and not violate scientific principles. The course in electricity, for these reasons, has been aptly termed "a course in practical electricity." The note books exhibited give a good idea of the wide scope of the experimental work done, including many tests on primary and secondary batteries, the tracing of magnetization and permeability curves, calculations of magnetic circuits of various types of dynamos and motors and tests of dynamos, arc lamps and meters. The note books are neatly kept and each experiment is accompanied by a sketch, photograph, or blueprint. By means of small models the boys are shown how to trace out magnetic fields and on large porcelain slabs are shown by means of iron filings the results of this diligent work.

There is also shown a vertical section of a dwelling house containing in the basement engine, boiler and dynamo. The house is completely wired for six incandescent lamps and the dynamo is run as a motor from an outside source, driving the engine instead of vice versa, which of course is not apparent to the casual observer and does not detract from the usefulness and beauty of the apparatus. The electro-mechanical work is carried on under the direct supervision of Mr. E. V. Lallier, while Mr. W. W. Ker assumes all responsibility for the theoretical instruction including experimental work. The success achieved by the graduates of this institution in the electrical field speaks very highly for the splendid course taught by these two gentlemen. Mr. Ker, in particular, has been wonderfully successful in teaching theoretical and thoroughly practical electricity to boys of such extreme youth. The school is located at 34 and 36 Stuyvesant street, and contains perhaps the most complete electrical laboratories and well equipped shops of any educational institution of a similar kind. The instructors have arranged a collection of practical appliances loaned or given by manufacturers which aids materially in conveying to the boys an idea of apparatus in every day use. The next class will be graduated on June 23, and equipped as they are with the splendid training received at this school they should have little difficulty in obtaining positions.

Exhibit of the Cleveland Twist Drill Co.

THE Cleveland Twist Drill Company, 99 Reade street, New York, exhibited at the Electrical Exhibition in a handsome glass case, a large variety of twist drills, reamers, cutters, oil tube drills, etc. The exhibit shows up the fine workmanship of the company, as well as the great variety of tools which they manufacture. One of the features shown is the electrician's bit and fish wire combined. By means of the holes drilled through the centre web of these bits, electricians can fish their wires without the use of a secondary tool for that purpose. All bits up to and including 10-32-inch diameter have "fish holes" for No. 14 wire, after the insulation has been removed. Larger bits will be provided with larger holes, if required. All bits are made from the best steel, and are said to be the finest finished

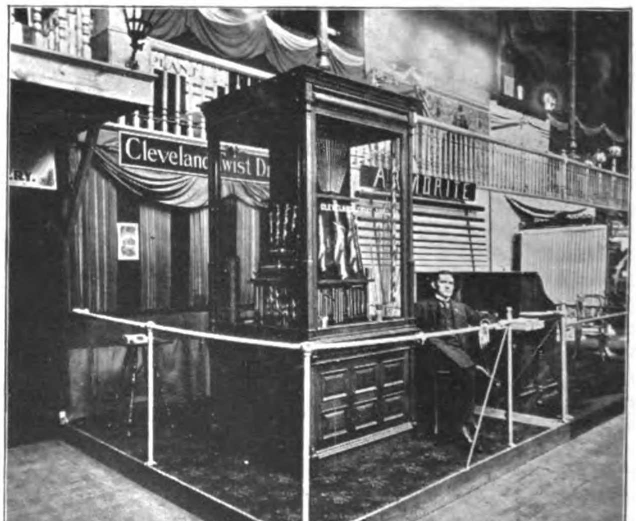


EXHIBIT OF THE CLEVELAND TWIST DRILL COMPANY.

tools on the market. A very pretty souvenir in the form of a nickeled twist drill, to be used as a watch charm, is given away by this enterprising company. Mr. E. H. Jung was on hand to answer all inquiries regarding the company's products.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—XIII.

BY A. E. DOBBS.

HINTS ON EXCHANGE MANAGEMENT.

THE most important details connected with telephone work relate to the central office itself, and one of the most important of these is in regard to the service rendered.

Telephone service, to inspire confidence must be prompt and reliable, and a manager with comparatively inefficient instruments and lines, who looks sharply after the service and keeps his trouble out, will be on a great deal better terms with his subscribers, than one who, having the very best instruments and lines that experience and money can procure, neglects this important condition. For the best instruments now made will occasionally go wrong. No matter how carefully lines are built, they will sometimes break or cross.

Let us cite an example: A and B are rival managers of two exchanges in the same town, and both have about the same number of subscribers; A has a good plant and instruments that are up to date, but he cannot be made to see the necessity of attending to service details. His operators do not always attend strictly to business, and he never seems to find it out. Lines may get in trouble and remain so for a week (this is no exaggeration), and even when the operator reports a line as working badly, he seems to think that he has other work of more importance to attend to, so that the operators have got discouraged and quit reporting trouble. His employés, too, have caught something of the same spirit and have got into the habit of "letting things go." B, on the other hand, looks sharply after his trouble and instructs his operators to report it promptly as soon as discovered. His tours of collection are tours of inspection as well, and his operators understand that if they do not answer calls promptly they are liable to have some one else filling their places. Whenever he is in office he will take pains to call their attention to calls that are not answered as they should be, not harshly, for he is one of the best fellows alive; but attending strictly to business himself and all his office employés understand that they are hired to do the same, not to gossip or read novels, and that patrons must get the service they pay for, and in disputes between operators and subscribers, which will occur in the best regulated exchanges, they know that he will stand by them unless they are altogether in the wrong.

No matter what work he has on hand, trouble must be taken care of as soon as reported, even though a whole gang of men is kept waiting.

Now all this seems severe, yet his general good nature and unfailing courtesy make him a favorite both with employés and subscribers, and in the course of a year he begins to cut into his opponent's subscription list and A is still wondering why people prefer B's service to his own, forgetting or not knowing that his own neglect created grumbling, induced lack of confidence, and made enemies of the very men who were helping him in his business.

When a subscriber finds that he cannot raise "Central," he feels exasperated and not without reason, as he is paying for a continuous service, and has learned to depend upon the telephone the same as he would upon an employé, with this difference, when an employé is sick or absent the fact is generally known, and arrangements made to fill his place; but with a telephone out of order the fact is not discovered, perhaps, till the busiest part of the day, and its place can only be filled by a messenger. Again in some offices where there are only from 50 to 200 subscribers, the operators are perhaps young and giddy girls, or still more young and careless boys, who cannot always understand—unless reminded of it—the necessity of answering a call the very instant that it comes in. Perhaps they want to get to a stopping place in the book they are reading, or finish an interesting gabble with some clerk or "lady friend," while the impatient subscriber has to wait 10 or 15 seconds, which seem like so many minutes, and perhaps has to ring another time or two, before he is answered. Soon he begins to talk among his acquaintances about the "one horse exchange" and "poor service," and some day he goes over to the opposition company and perhaps takes some of his friends along with him. You may think that certain men are too mean to have any friends, but nearly all mankind is more or less amenable to suggestion, and while the above remarks may have no present influence, yet the people to whom they are made will remember them the very first time they have trouble with their own instruments.

Now all operators are not like this, but business heads cannot be expected on young and inexperienced shoulders, and the best of them need watching occasionally. Do not let them forget that they are there to serve the public first of all and remind them that troubles discovered should be promptly reported, and give them to understand that they will be as promptly attended to.

The saying of a Western electric light manager is apropos, "Keep the lights going, if the engine goes in the scrap heap to-morrow," which, being applied to telephone service, means: A subscriber wants to be answered as soon as he calls, and he wants the exchange every time he calls.

But prompt service is not the only thing necessary in training operators.

The work of operating a busy switchboard is confining and often irritating. The very best systems yet devised have their faults, and some of the newer boards have many. Subscribers feeling out of humor show a disposition to find fault, perhaps because the party called for does not answer promptly, or the line is "busy." In large exchanges operators are not allowed to converse with subscribers during business hours and patrons showing a disposition to argue matters are either shut off or switched over to the chief operator, but in the smaller exchanges there is no chief operator; the manager is away from the office fully half the time, and the girl has to bear the brunt of complaints and fault finding alone. In such a case of course the young lady must be schooled to control her temper under all ordinary circumstances.

In a circular issued by certain railroads to employés occurs this sentence:

"Employés should show to patrons the same tact and courtesy that a business man would use with his customers."

It would be well to post this up in every exchange.

Many operators have such pleasant voices and pleasant ways that it is really a pleasure to call up the exchange. What though an operator is "quick as lightning" and can put up plugs at an astonishing rate if her call of "Number!!" makes a timid subscriber start back in alarm, and who upon the least provocation replies in language blunt as well as vigorous? Such a one is not fitted for the telephone business and should try some other occupation. On the other hand, it is worth considerable to an exchange to have its plug manipulators spoken of as "such nice, pleasant girls," "so accommodating," etc. Remember that the public judges an exchange largely by its operators, for, after the instrument is once installed, they see and hear very little of anyone else except the collector. The general public does not know of the work that operators have to do, and to enlighten them it is a pretty good idea to invite them to call and see the exchange in operation, where a little courtesy on the part of manager and operators will prevent a great deal of fault finding and establish a personal acquaintance which will create a better mutual understanding all around. Operators will generally try to please, for approbativeness is a woman's leading characteristic and a hint or suggestion covering these points, will generally be sufficient, for every girl likes to be well thought of.

But there is another quality in a girl's disposition which is not so easily controlled, viz., curiosity.

There is a general disposition on the part of young operators to cut in and listen to conversations, and even in some cases repeating what they hear. Now I know that as long as human nature remains as it is, that it is hard to break up this habit unless she is fully occupied otherwise; but there are several reasons why this is wrong.

Every message between patrons should be regarded, by operators and officials, as confidential, never to be divulged under any circumstances, unless perfectly sure the parties would not object. If, however, the operator stays off the line, she will not hear anything she should not. Again, the girl should be instructed that every time she cuts in she throws either the resistance and self-induction of her own instrument into the line or throws in a "ground" reducing its efficiency in either case by that much. Suppose that two subscribers, owing to long

lines, poor instruments, or a noisy location, can make themselves understood with difficulty, the operator by cutting in will increase the difficulty almost two-fold.

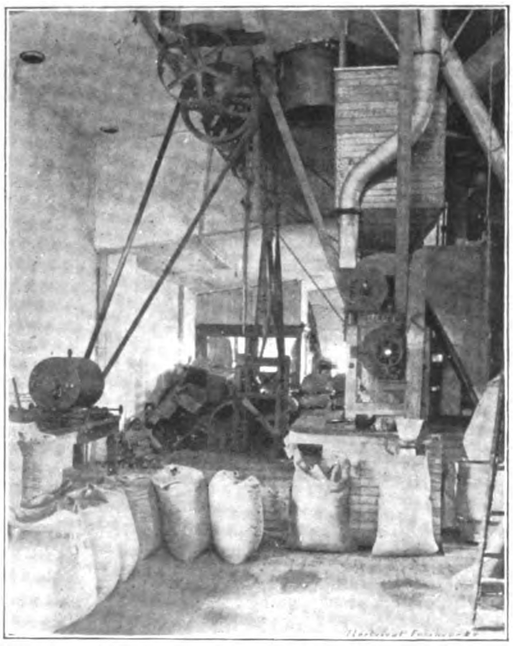
To be sure some patrons will not ring off when through talking, and the operator has to cut in to find out if they are through, but even then it is not necessary to cut in directly, as by putting one hand on the base of the plug and the other on one of the binding posts of the receiver she can shunt enough of the current to hear perfectly everything that is said, and even answer them if necessary. I know of one exchange where the operators use this plan almost altogether for cutting in after the plugs are up, while the high and non-inductive resistance of the body prevents any appreciable loss of current.

Give the girls all the conveniences and comforts that you can. Do not compel them to acquire a lame arm turning a hard, stiff hand generator; if you can procure a steady, reliable power in your neighborhood, such as a small gas, water or electric motor, or a factory shaft running continuously, to turn it for them. Make the place attractive and show them the little attentions which they so much appreciate and the strictest discipline will hardly be felt.

C & C Electric Power Plant in L. H. Parke & Co.'s Coffee Roasting Establishment, Philadelphia.

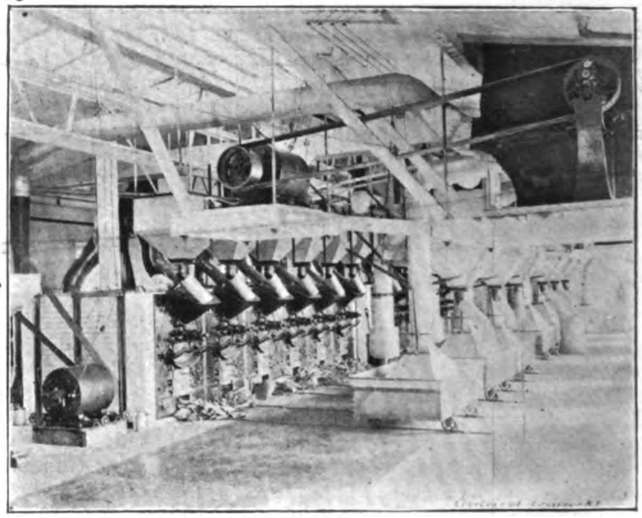
WE have in the past illustrated numerous electric power installations in industrial establishments, but none is, we believe, more characteristic of the adaptability of the electric motor than that recently carried out by the C and C Electric Company at L. H. Parke & Co.'s establishment in Philadelphia.

The former occupant and owner of the present premises occupied by L. H. Parke & Co. since March 1, had installed a side crank Buckeye engine, which drove a shaft on the ceil-



COFFEE ELEVATING AND WEIGHING MACHINE.

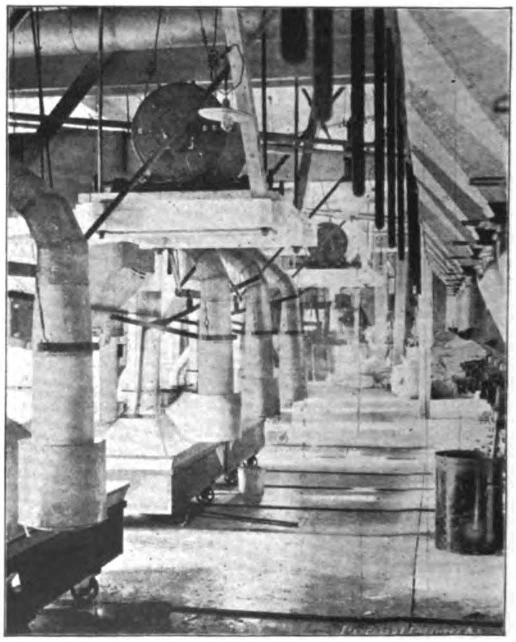
ing of the basement, which shaft in turn drove a vertical shaft to the top floor of the building, where it was necessary to have the power. Mr. Parke, who is quite a mechanical genius himself, and who is acting for a firm comprised of young and very progressive business men, decided to abandon the entire system of shaft and belt transmission, and as soon as they got possession of their present building they called in Mr. William Myers, of the Philadelphia office of the C and C Electric Company, and together with Mr. Parke they designed and installed the present power plant, which consists of a four-pole generator of the C and C company's latest type, for belted work, and eleven of the C and C ironclad type four-pole motors, which are entirely enclosed. These motors range from 5 to 10 h. p. in size, and each motor is belted direct to its work. Under the old system that was in use in this building they could not have delivered more than 40 h. p. on the top floor, whereas they are now



COFFEE ROASTING FURNACES AND COOLING BINS.

using more than 70 h. p. The gain is, of course, in the transmission.

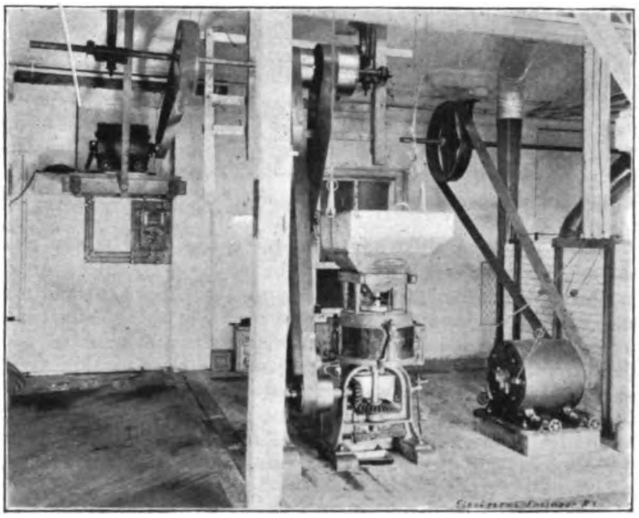
The coffee is brought to the top floor of this building just as it is imported from the foreign countries. It is full of dust, gravel and other foreign matter, which has to be separated from the bean. The coffee is first passed over a picking table, which consists of an endless canvas belt about 50 feet long, which travels at a low rate of speed, and each side of the table is lined with small girls, who pick out the foreign matter somewhat in the way that slate is picked from coal in the coal mines. The



COFFEE COOLING TRUCKS.

coffee then passes into a hopper through a conveyer, built by the Link Belt Engineering Company, which carries it to the milling machines, where all the dust, pieces of twine and any other substances which escape the picking table are separated from the bean, and the bean passes into receivers perfectly clean and graded, there being nothing remaining in the first grade but the largest and purest beans.

These beans are then carried overhead by a bucket elevator, which was also built by the Link Belt Engineering Company, and is emptied into a trough, which runs the entire length of the battery of roasting cylinders. Each cylinder is provided with a hopper, which holds one charge for a cylinder. Directly over these hoppers are slides worked by a lever, and as the hoppers need replenishing the opening is made and the conveyer drops the coffee in until the slide is again closed. The coffee is then



COFFEE GRINDER.

passed from the hopper into the cylinder by opening a slide at the bottom of the hopper.

After being roasted, the coffee is dumped into a "cooling box," which consists of an iron box about 4 by 6 feet and 18 inches deep, and has perforated sides and bottoms. The cooling box is on wheels and is rolled under the cooling apparatus, which consists of a hood, which fits into the top of the box and sucks a strong blast of air through the coffee and out to the open air. In about a minute after the coffee is placed under the cooler, smoking hot out of the roaster, it can be pushed under the stoning machine and carried up to the bin overhead by the suction of

AUTOMATIC PACKAGING MACHINE.

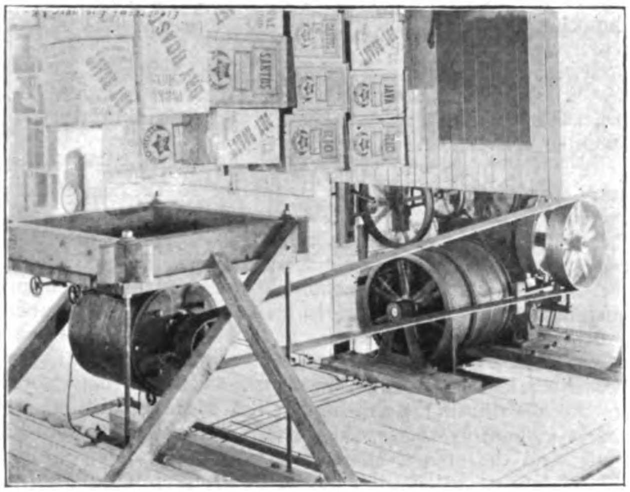
air. This air draught is regulated to a nicety, so that it will leave all gravel or anything which may have escaped the other processes.

From the bins overhead the coffee is passed to the next floor below, where the entire sides of the room are taken up by galvanized iron bins for storage. From these bins the coffee is passed to the third floor, where it is received in bins and hoppers overhead and is weighed and automatically packed in 50-pound tin cans, which are crated, and in one-pound paper packages, which have been treated with a process which renders them air-tight. The coffee is then placed on trucks which run directly on to the elevator and down to the shipping floor, and is immediately shipped out.

The plan of the company is to prepare coffee just as they have orders for it, thereby furnishing their customers always with fresh goods. The capacity of their mill enables them to do this.

The elevator in this establishment is operated by a C and C motor of the ironclad type, 7½ h. p., and is reversible, driving direct on the winding machine, no countershaft being used at all. In the roasting department there are two 10 h. p. motors, each driving a battery of roasting cylinders, and installed in such a manner that the driving shafts of each battery join with a clutch coupling, so that in case either motor should blow a fuse or open a circuit the clutch can be thrown in and the other motor can take care of the load until the repairs can be made. Every motor in the building is equipped with an automatic circuit breaker for overload and automatic release for current interruptions.

There are three 10 h. p. motors connected direct to Sturtevant blowers. There are also motors of various sizes driving the milling machines, granulating mills, pulverizing mills, etc. The accompanying engravings show a number of views in the establishment.



FREIGHT ELEVATOR MACHINERY.

The switchboard, designed by Mr. Myers, consists of two panels, one of which has the Edison service connected to it by double throw switch; the other is used exclusively for the C and C generator. The entire switchboard is connected up in such a manner that by opening or closing the switch the entire switchboard can be used upon either system. There are recording wattmeters for ascertaining the monthly output of the plant, one on the dynamo circuit, one each on the arc light, incandescent light and power circuits.

The plant is well worth a visit to anyone interested in electric power transmission, and Mr. Parke gives a cordial welcome to all visitors.

Electric Power in Lumber Mills.

Among the latest applications of electric power is one in the line of lumber mill machinery. The Westinghouse Electric and Manufacturing Company are installing for the Berlin Mill Company, of Berlin, N. H., two 180 kilowatt 400 volt generators, with a large equipment of their well known type C induction motors, for driving, planing and grist mills, machine shops, and for lighting the plant. The installation is especially interesting as illustrating the use of alternating apparatus for short distance transmission, the extreme distance of any motor from the generator not exceeding 350 feet. Another electrically equipped lumber mill supplied by the Westinghouse Company is that of the M. G. Shaw Lumber Company, of Bath, Me.

MISCELLANEOUS

A Chart For Determining the Most Economical System of Conductors.[1]

BY A. B. HERRICK.

THE general problem of the best conductor system that can be devised to supply fixed centres of distribution with the least first cost and energy loss, involves a number of variables which can be assigned fixed values in order to simplify the problem of the conductor system only, and apply to the different methods commonly used for current distribution.

On sheet No. 1 are laid out centres of distribution at fixed distances from the station. These distances and centres are shown on the right hand margin of sheet No. 1, and each centre has been assumed to take at the peak of the load 5.5 k. w., with a 20 per cent. energy loss.

To make all the systems comparable, it is assumed that the load on the whole system rises uniformly to obviate the equalizing of the feeder loads by the mains.

The vertical line at A is the line from which the weights of copper required for each feeder feeding to each individual consumption centre are laid off horizontally. Each horizontai space represents 10,000 pounds of copper. For individual feeders these weight lengths are included between line A and curved line A B. The aggregate weight of copper required to feed the whole system to any point of the distribution system is included between line A and curve A C.

At B, the three-wire system 110 volts delivered to the mains at 20 per cent. energy loss is applied to the same territory, the line B B being the weight of individual feeders, and B C the aggregate weight of all feeders covering the expansion of the system from the source of generation at B.

At C is shown the application of the single-phase alternating current system 1,012 volts. In this application the copper and transformer is first figured for a 20 per cent. energy loss, and where each transformer is located, its commercial value in copper equivalent is added. This transformer delivers its current to the distributing point under the same conditions as the direct current systems. At D the voltage is raised to 2,024 volts, and the copper again determined for the application to this system of distribution under the same conditions of energy delivery as in the other methods shown. For the range which was selected in order to include the class of problems most generally arising, the three-phase, both delta and Y connection, and the two-phase systems, show too little departure in weight of copper to be graphically differentiated from the single-phase system shown, that is, up to 10,000 feet.

Sheet No. 2 shows the commercial and investment values of these systems. As applied in this case the horizontal lines are dollars, each space representing one thousand dollars. The investments for the two-wire system of distribution are laid off from the line A′, the curve A′ B′ showing the cost for each individual feeder to these points of distribution; and curve A′ C′ indicates the aggregate costs for all copper required to cover this territory. Furthermore, as this copper investment involves an interest and depreciation charge, which must be earned through the sale of the energy it conducts, it is graphically shown that a copper system may be used which will absorb for the fixed charges against the copper cost all possible profit that can be derived from the sale of the energy it conducts.

In order to divorce the variable cost of production from the diagram, it is assumed that the energy is delivered at the feeder having in it a profit of five cents per k. w. hour, the load factor being taken as 30 per cent. Under these conditions the line X Y shows the absorption of this profit by the fixed conductor charges, and after it passes the line A′ to the right it becomes a loss to use this system as a means of supplying energy beyond this point. As the potential increases, this point of loss travels further away from the generating station. The commerical treatment is in the same way taken up for the three-wire system, single-phase 1,012 volts, and 2,024 volts. In the case of the alternating current, the transformer value is added in each case to the copper line value so as to reduce the systems to the same basis of comparison, a transformer of full capacity being used at the centres of distribution.

In the practical application of these diagrams the following points are shown: The exact distance that a given weight of copper will extend a distribution. When using any of the systems illustrated it also shows which system would return the maximum revenue, with a fixed consumption circuit. It is evident that in the problem selected neither a two-wire nor three-wire system is commercially feasible, as the area of loss on the right side of the datum line is greater than the profit area on the left side included between the line X Y and the datum line. If a reasonable profit is desired in distributing to these consumption centres, the graphic method shows that a high potential system should be used when considering the supply of this system from the standpoint of the copper plant only.

Other modifications have to be made which may change the economical area which can be covered by these different systems; the higher the cost of laying the copper the more contracted will become the profitable area for these different systems. All-day losses in the transformer will tend to reduce the difference between the low tension and high tension systems, in regard to the profitable area over which they can extend, but these are conditions external to the copper plant. The graphic method is offered for the purpose of establishing some of the relations in the much involved problem of conductor systems.

[1]The chart referred to forms a supplement accompanying this number of The Electrical Engineer.

Manufacturers and Dealers in Electrical Supplies in Baltimore.—Notes From the Field—III.

BY C. B. FAIRCHILD.

McCAY ENGINEERING CO.

THIS company not only deal in electrical supplies of almost every description, but are also contractors for the installation and equipment of isolated lighting plants, including the engines, both for private and public buildings, parks, steamships and Government signalling stations. They are also agents for the sale of the Interior Conduit Company's products, and also manufacture several specialties, including the McCay regulating socket for alternating current incandescent lamps; they also manufacture marble switchboards for use in lighting and power plants.

The regulating socket is an ingenious piece of mechanism by means of which the candle power of a lamp can be decreased by successive stages from its maximum brightness to a dull red glow, with a corresponding saving of current, and an increase of life to the filament; this is done, however, without the use of resistance coils or other current consuming devices. The advantage and convenience of being able to turn down an incandescent lamp, and yet keep it burning, as can be done in case of a gas burner, is apparent.

The socket proper, by which the above results are accomplished, consists of a hollow metal cylinder about 1¾ inches in diameter and 2 inches in length, the bore being about ¾ of an inch in diameter. This cylinder or core is made up of thin washers of metal, which are stamped out with a die; these are then put together and taped as for a magnet coil. This is then wound in perpendicular coils with a seven wire cable, from which each wire terminates in a separate chamber in a porcelain block, which is adjusted to fit the cylinder, and which carries a small switch by means of which each of the seven wires may be cut out in turn. With all the wires cut in, the light is modified, due to the reactance effect, and the range is from 50 to 5 volts. The sockets are made for a current of 16,000 alternations, and for 50 to 100 volts; also for 7,200 alternations having the same voltage.

The shops of the company are located on German street, and occupy two buildings, with suitable machinery for manufacturing the special products which are put out. Among the machines may be noted a punch, by means of which the washers, composing the lamp sockets are made at the rate of 40 a minute. There is also a machine for drilling marble slabs for the purpose of attaching the switches and instruments, which are required on a switchboard; in this machine a drill is mounted on a radial arm 4 feet in length, thus giving a range for work over a wide slab of marble.

Among the lighting contracts on which the company are now engaged, are the post office at Washington, D. C., with an in-

stallation of 20,000 incandescent lamps, also a motor battery station at Fort Monroe, for the Government, which is to be run by portable storage batteries. There is also a Government contract for lighting on Great Gull Island, in Long Island Sound, opposite New London, Conn.; the power for this plant is furnished by a Hornsby-Akroyd oil engine.

SOCIETY & CLUB NOTES

New Members of N. Y. Electrical Society.

The following is a list of the new members of the New York Electrical Society elected at the last meeting: B. B. Hoffman, Douglass Burnett, Leo R. Manheims, W. S. Atkinson, W. J. Schweiger, John O'Connor, Charles H. Kienle, William W. Rosenbaum, M. J. Adler, George J. Schoeffel, W. S. Alexander, E. Bradford Bumsted, Julius W. Eichler, Arthur H. Brown, Walter A. Houghtaling, Sterns Francis Jones, I. W. Smith, James H. Campbell, Farley G. Clark, Charles F. Bauer, James B. Faulks, Joseph Bijur, H. L. Shippey, H. H. Harrison, C. D. Taylor, George Clapperton, Samuel Van Ronts, G. A. Robertson, J. E. Sleight, Otto Kartzmark, John W. Schroeder, O. A. Sandborgh, Albert Flammer, Charles Meyer, Fred Joerg, Adrian Chamberlain, F. W. Roebling. The society closed its year at this meeting with 607 members, of whom 215 have been elected during the year.

Convention Invitations.

The Chicago Edison Company has invited members and friends of the National Electric Light Association to visit its various stations for purposes of inspection, and the Electric Storage Battery Company has also issued a special invitation to an inspection of the large storage battery that has been installed for the Edison company in the Edison building on Adams street. Without doubt, these courtesies will be largely availed of during the present week.

NEWS AND NOTES

A Fatal Accident on the Hartford Third Rail System.

The first fatal accident from the effects of the third rail took place Thursday evening, May 26, when Harry Ray, 21 years of age, was killed in the rear of his home in West Hartford.

He walked down the tracks to the rear of his home, and in crossing the rails he either stumbled or stepped on the electric rail and fell from the effects of the shock. On account of the heavy rains, everything tended to increase the flow of the current through his body. Ray struck the rail on the back of his neck and was badly burned.

Some persons have escaped with burns and a number of animals have been killed, but this is the first fatality.

Short Distance Alternating Transmission, Fitchburg, Mass.

A good example of the use of alternating current for short distance transmission ease of starting the motors from a distance, reversing the same, etc., is to be found in apparatus now being supplied for the Fitchburg (Mass.) grain elevators by the Westinghouse Electric and Manufacturing Company. This consists of one 125 k. w. two-phase generator, seven 20 h. p. and two 30 h. p. Westinghouse type C motors, to be used in operating carriers in elevators. The induction motor is especially adapted for work in dusty locations, such as the above, where the use of direct current motors would be out of the question.

ROENTGEN RAYS

Roentgen Rays in War.

The first report of the use of the Röntgen rays in warfare has been made at the United Service Institution, in London, by Surgeon Beevor, who described the results of their use in the recent frontier campaign in India and gave lantern views. Many important cases consisted of bullet wounds received by officers and men who were injured in the bones, joints, and internal organs. Their injuries but for the X-rays would have resulted in the amputation of limbs and probable loss of life. The pictures shown included wounds in the arm, leg, chest, back, finger, and other parts. The most remarkable results, perhaps, were a case of a bullet embedded in the backbone, another in the hip, and the case of an Indian soldier who was shot in the foot, pieces of the bullet finally lodging in the back of the heel; also the case of Gen. Woodhouse, who received bullet wounds in the leg and arm at Dargai.

In all the instances enumerated the bullets were by the use of the X-rays successfully removed, the men subsequently rejoining their comrades at the front. The portable apparatus weighs 80 to 100 pounds.

REPORTS OF COMPANIES

Hartford, Conn. Electric Light Plant,

The board of directors of the Hartford Electric Light Company has voted to increase the capital of the company by the addition of $100,000 to the present capital of $400,000, which increases it to the limit allowed by the State Legislature.

The increase is to be offered to the stockholders on the basis of one share to every four now held, and the payments will be called for at the rate of 50 per cent. on July 5 and the remaining 50 per cent. on October 5. The books will be open June 15. During the year the plant has been entirely remodeled and the work will probably be perfected by January 1.

The big storage battery building on State street has been remodeled and is nearly completed.

A new steel and iron roof has been put in place, and a solid brick wall has been built between the battery room and the dynamo room. Everything is as nearly fireproof as is possible to make it. The business now done by the company is increasing steadily. At present the company is running over 36,000 incandescent and between 1,400 and 1,500 arc lights.

THE STOCK MARKET

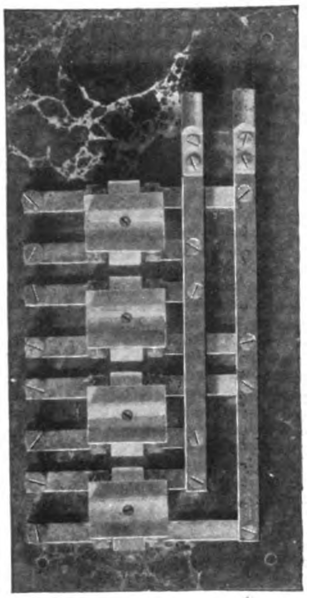
Crops and the State of Business.

Trade is generally good, quiet in some departments and brisk in others; on the whole, reports are cheerful with a strong tone. Agricultural conditions are most encouraging, and the wheat prospects are said to indicate a very large crop. May bank clearings were very heavy, showing a gain of seven per cent. over April, and of 28 per cent. over last May, 1897. Retail trade, checked by the wretched weather of May is good everywhere now.

The stock market has been very active, with a marked upward tendency, taking for granted the final defeat and wiping out of Spain. Railroads are doing well and paying higher dividends. Government bonds are higher, the new 4s going to 123. Western Union closed on Friday at 91⅝, General Electric closed at 36½, American Bell Telephone closed at 277, a gain for the week of 11 points. In Boston, copper stocks are higher. Copper is quoted at 12 cents, and heavy steel rail, Eastern mill, at $18.

TRADE NOTES & NOVELTIES

Zimdars & Hunt Specialties.



A NEW catalogue has just been issued by Zimdars & Hunt, 127 Fifth avenue, New York, (known as Cat. B.) dealing exclusively with panel, feeder and distribution boards. This is the first catalogue to appear covering completely this line, and its value to the trade, contractors and engineers especially, cannot be underestimated. While innumerable catalogues covering about everything else used in installation work have appeared, up to this time no catalogue dealing in a comprehensive manner with these articles has been available. The reason for this is probably to be found in the fact that the use of panel and feeder boards instead of the old porcelain cut-outs is of comparatively recent origin. The manner in which this matter has been taken up and handled in this catalogue reflects great credit on the firm. In looking over this catalogue, we find illustrated and listed in a systematic manner about all the types of panel and feeder boards anyone could have use for. Besides all those general types which from their extended use have now come to be looked upon as standards, we find many new and desirable types which should find a ready field. The matter throughout the catalogue is arranged in a very clear and comprehensive manner, complete prices and catalogue numbers being given in such a way that the possibility of mistakes occurring in referring to them is obviated.

Dimensions are given of all boards listed, and this feature will prove of incalculable value to the contractor who has been compelled heretofore to guess at the probable sizes of the boards he contemplated using.

The catalogue is very finely illustrated, the half-tone illustrations showing clearly all the distinctive features of the various types.

The cover, like that of this firm's catalogues A and C, is an exact imitation of marble, with copper embossing, and is a work of art.

This catalogue should prove a valuable acquisition to supply houses, contractors, and engineers, and can be obtained by addressing the above firm.

Sales of Walker Co.'s Apparatus.

Among the recent orders received by the Walker Company may be mentioned the following: One 250 k. w. belted railway generator and four double 4-A-S-1,000 railway equipments, for the Holland (Mich.) & Lake Michigan Railway Co. One 50 k. w. direct connected lighting generator for Russell & Co., Pittsburg, Pa., to be shipped to Sewickly, Pa. One 250 k. w. belted generator for Norton & Taunton (Mass.) Street Railway Co. One 30 k. w. direct connected generator by S. M. Fischer, Chicago, for the Patton Motor Co., same place. One 30 k. w. generator for W. A. Johnson Electric Co., Toronto. One 200 k. w. direct connected generator for Lewiston Electric Light Co., Lewiston, Idaho. Two 225 k. w. belted railway generators for the Wheeling & Elm Grove Electric Railway Co., Wheeling, W. Va.

The United States Ordnance Department has taken six 10-inch disappearing gun carriages for coast fortifications. The following orders for foreign shipment have been received: Edgar C. Moxham & Co., New York City, for Manaos Railway Co., Brazil, three 130 k. w. direct connected railway generators. Through agents in Japan, Messrs. Bagnall & Hilles, Yokohama, one 75 k. w. railway generator and switchboard apparatus and two double railway motor equipments, of 3-S-800 motors. Through London agency: Fifteen double equipments of 33-S-800 motors and type SL controllers. Two 120 k. w. railway generators with switchboard apparatus. Five double railway motor equipments of 3-N-800 motors.

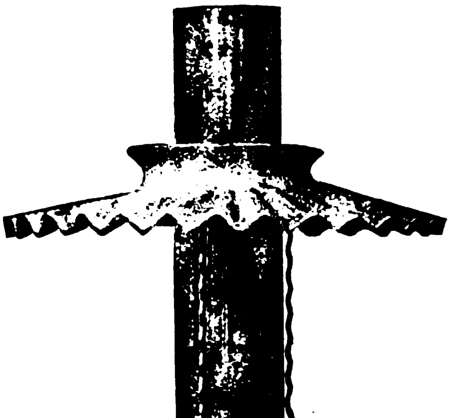
Thomas & Betts.

Robert McKean Thomas, E.E., and Hobart D. Betts, E.E., have organized a partnership under the firm name of Thomas & Betts, and have opened well equipped offices at the new Washington Life Building, corner of Liberty street and Broadway. The concern will act as agents for various well known electrical specialties, including the new "loricated" iron pipe interior conduit. They also carry on a general contracting and consulting business. Both gentlemen bring with them a large and varied experience. Mr. Thomas was for over two years assistant chief inspector of the New York Fire Department Electrical Inspection Bureau, and Mr. Betts has been an active member of the Edison Illuminating Company's staff.

Electric Gas Lighting Attachment for Incandescent Burners.

To use an old and threadbare phrase, there has been, since their introduction, a "crying demand" for a practical and low-priced method of lighting incandescent burners by electricity. This demand has been created by the inconvenience of lighting this burner when it is used on high chandeliers, and in the chain-pull style by the great danger of breaking mantles from the jar created in operating same.

To meet this demand an attachment has been designed which



ELECTRIC GAS LIGHTING ATTACHMENT FOR INCANDESCENT BURNERS.

embodies the improvements found in the "Advance" electric gas lighting burner. Among them are the smooth, easy action in lighting, which will not break the mantle; its operation is by key, in the same manner as the ordinary gas cock, and the fact that there is no possibility of the burner becoming short circuited in extinguishing. An additional feature is an adjustment in the pilot tube, by which the size and height of the pilot frame can be regulated. This obviates the blackening of the mantle, frequently found in burners lit from a pilot tube where too large a flame issues from same. The attachment can be used with the genuine Welsbach (as shown in illustration) and a majority of

the other incandescent burners now on the market. It is said to require but a few moments to attach. Stems are furnished in any length, but are sent four inches long unless otherwise specified.

The Electric Gas Lighting Company, 192 Devonshire street, Boston, Mass., are the manufacturers of this device, which is meeting with a ready sale. Descriptive circulars will be mailed upon application.

Fort Wayne Electric Corporation.

One of the interesting features of the electric lighting at St. Louis, Mo., as illustrated in our pages this week, is the large number of Fort Wayne wood arc dynamos in the plant, as illustrated in the engravings. The Fort Wayne Corporation remains still active and prominent in the arc lighting field where it has been so long and so favorably known. This fact is brought out and emphasized by the announcement made in our advertising pages, where the corporation show their beautiful No. 9 A machine with its new, improved regulator. The new No. 9 B 125 lighter is of the same type as the 9 A, with the new and improved regulator. The qualities of this apparatus are such as to commend it strongly to the favor of all engaged in the work of arc lighting, and there is no doubt that it will be as largely employed as that which has hitherto been everywhere recognized as highest grade and standard.

Bryant Electric Co.

The Bryant Electric Company, of Bridgeport, Conn., are erecting a new two-story power house 50 feet square. The building has brick side walls, and the framework is of steel skeleton type. The floor of the building is supported on heavy girders and columns, which carry steel joists supporting corrugated iron arches and concrete floor. The roof has clear span trusses carrying corrugated iron covering, lined with patent anti-condensation roof lining, which prevents the condensation of moisture on the underside of the roof covering, and avoids any damage or inconvenience from moisture dropping on the delicate machinery or material on the floor below. This building was designed and the steel material furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn. The Bryant Company is increasing all its facilities for a large output.

Activity of the Central Electric Co.

In addition to their usually complete line of fan motors operative upon electric light circuits, the Central Electric Company, of Chicago, in order to meet the gradually increasing demand, have placed in stock a very complete line of fan motors operative from storage and primary battery circuits, prominence being given to the Edison-Lalande battery fan outfits. There is many a place and many a time when these atmospheric alleviators prove very serviceable. In a sick room they serve to keep a gentle circulation of the air that is exceedingly refreshing to a patient. Special circulars will be sent on application.

The Central Electric Company announce that they have taken the agency for the products of the Varley Duplex Magnet Company, of New York, manufacturers of magnets of every description, and will carry in Chicago stock all styles of standard coils for telephone construction. Special designs will be furnished on application.

Developments at Niagara.

The Carborundum Company, of Niagara Falls, are about to make a distinct departure in a business way from their present interests. They will erect a brick building three stories high, 50 feet wide by 228 feet long adjoining their factory on the Niagara Falls Power Company's lands in which carborundum will be spread on cloth and paper, and possibly leather. This step will place carborundum in direct competition with the emery, garnet and flint cloth manufacturers of the United States, of whom there are seven or eight. It will open up a branch of business which no doubt is destined to grow until the volume exceeds their present business in carborundum wheels, etc. The growth of the business will probably result in additions to the carborundum producing plant, steps to enlarge which are understood to be in progress.

The Mathieson Alkali Works, at Niagara Falls, are to be materially enlarged. This plant now consumes 2,000 electrical horse power. It is located on the lands of the Niagara Falls Power Company, its buildings covering more space than any other factory at the Falls. Additions are to be built until 6,000 electrical horse power are consumed. Manager B. F. Thurston is now at work considering the plans, and it is expected that work on the new buildings will begin within 60 days. This company have works in Saltville, Va., and offices in New York and Providence, R. I. They have found the use of the constant electrical power of Niagara so beneficial that they gladly avail themselves of more of it.

The Shelby Electric Company.

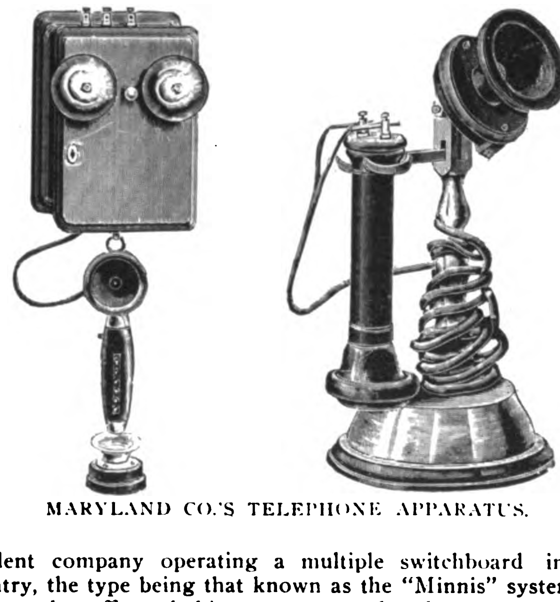
Owing to the increased volume of business the Shelby Electric Company, of Shelby, O., are now erecting an additional building adjoining the present factory. The new building is of brick, 34 by 80 feet, and three stories high. This addition will enable the Shelby Electric Company in doubling the present output of their well known Shelby lamp.

Sales of Onondaga Dynamos and Motors.

The Onondaga Dynamo Company, through their New York agents, Fairchild & Sumner, report the following recent sales: 190 h. p. in motors to the Atlas Cement Company, Northampton, Pa.; National Hat Company, Newark, N. J., 30 k. w. generator for lighting and heating; in the future the National Hat Company will do their flat-iron work by electricity; 5 h. p. motor, American News Company, Newark, N. J.; 10 h. p. motor to William T. Jancobius, electric carpet cleaning works, Newark, N. J.; 10 h. p. slow speed reversible elevator motor for the Causse Manufacturing Company, Jersey City, N. J.; 15 h. p. slow speed ceiling motor, the American Soda Fountain Company, Boston, Mass.; one 250 light lighting plant to Pass & Co., Wallabout street, Brooklyn, N. Y.; one 10 k. w. gas engine generators, with complete installation, for the Brown & Van Anglen Company, Newark, N. J.; 60 k. w. generator to the Paterson Silk Mills, Paterson, N. J. They also report their second installation of the special 60-volt exciter generator, direct connected, for the New York and Staten Island Electric Company, Livingston, S. I.

Maryland Telephone Mfg. Co.

The Maryland Telephone Mfg. Co. has been organized at Baltimore, Md., and has established a factory at 11 and 13 East Lee street, that city, under the general superintendence of Mr. C. B. Clark, formerly the electrician of the Home Telephone Company, of Mobile, Ala., which is said to be the only independent company operating a multiple switchboard in this country, the type being that known as the "Minnis" system.



MARYLAND CO.'S TELEPHONE APPARATUS.

The sales office of this company, under the management of Mr. Paul Minnis, the well known electrical engineer and telephone inventor, has been located at 130 Fulton street, this city, where may be found a complete line of up-to-date samples of the various types of telephones manufactured by the Maryland

company. This company is making features of the Brown loud-speaking transmitter and the Minnis system of telephones and switchboards; the latter being covered and protected by nearly a score of patents. The company is in the market for all kinds of exchange orders as well as orders for interior and intercommunicating sets, extension bells, desk sets, etc.

The officers of the Maryland Telephone Mfg. Co. are: M. Meyerdirck, president; H. H. Hebelman, vice-president; H. Knollenberg, secretary.

Four Hundred Pioneer Lamps Ordered.

Kaufman Brothers, of Pittsburg, have placed an order for over 400 Pioneer enclosed arcs for their new building with the Electric Arc Light Co., of New York. A unique feature of this installation will be the complete lighting of the store with arcs, and combination electric and gas chandeliers. This is the first store in the country to be entirely equipped in this manner. The Pioneer lamp was selected after a three months' competitive test.

WESTERN NOTES

WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, advise us that they are receiving a large number of suggestions of names for their new lamp, and as each suggestion must be accompanied with an order they are correspondingly busy. Some suggestions are of a character to provoke mirth and will be published after the contest is closed and prizes are awarded.

D. L. BATES & BRO., Dayton, O., report an excellent fan business this season. Their orders for the past month are fully 50 per cent. above the corresponding record last year. They report a phenomenal success with their alternating current ceiling fans. They are not only experiencing a brisk demand from the home trade, but are making large shipments to a number of foreign countries.

NEW YORK NOTES

MR. W. O. TURNER, who has for the past few years been connected with the Anchor Electric Co., of Boston, has resigned his position with that company and will now represent C. S. Knowles, of Boston, in place of Mr. A. T. Bell, who has become connected with the American Hard Rubber Co.

MR. R. J. RANDOLPH, who has for some years represented the Excelsior Electric Co. in Chicago, has come East and has accepted a position as general manager of the sales department of the Sterling Arc Lamp Co., of 214 West 26th street, New York City. Mr. Randolph is one of the old timers in the electrical business, having started with the late C. J. Van Depoele, in 1878, and he has been actively engaged in it ever since. He has a very wide circle of friends and will prove a valuable acquisition to the Sterling Co.

THE JEWELL BELTING CO., of Hartford, Conn., have opened an office at 1306 Washington Life Building, New York, which will be under the management of Mr. Edward C. Talcott, who brings with him a valuable experience gained by actual work in every department of the company's business. Mr. Talcott will be assisted by Mr. Ainsworth who has represented the Jewell Co. for some years in the Metropolitan district.

ADVERTISERS' HINTS

THE DEARBORN DRUG & CHEMICAL CO., Chicago, Ill., publish an unsolicited testimonial regarding the improved conditions resulting from the use of their boiler compound.

THE WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa., refer to some of the enormous contracts they have taken for alternating current generators.

THE EDDY ELECTRIC MFG. CO., Windsor, Conn., cite the advantages of the design of their motors and generators.

THE OKONITE CO., Ltd., 253 Broadway, New York, claim to be the largest contractors to the U. S. Government for submarine cables.

THEO. AUDEL & CO., 63 Fifth avenue, New York, advertise "Hawkins' Instructions for the Boiler Room," a book of considerable value to engineers, at $2.00.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, Pa., present a list of typical central station installations of chloride accumulators. It is a long one and bespeaks volumes for their efficiency.

THE PORTABLE ELECTRIC LIGHT CO., Chicago, Ill., advertise the "Marquette" headlight. It includes a dry battery for which they claim great things.

THE HART & HEGEMAN MFG. CO., Hartford, Conn., say that like a royal heart flush, their Hart flush switch is impossible to beat.

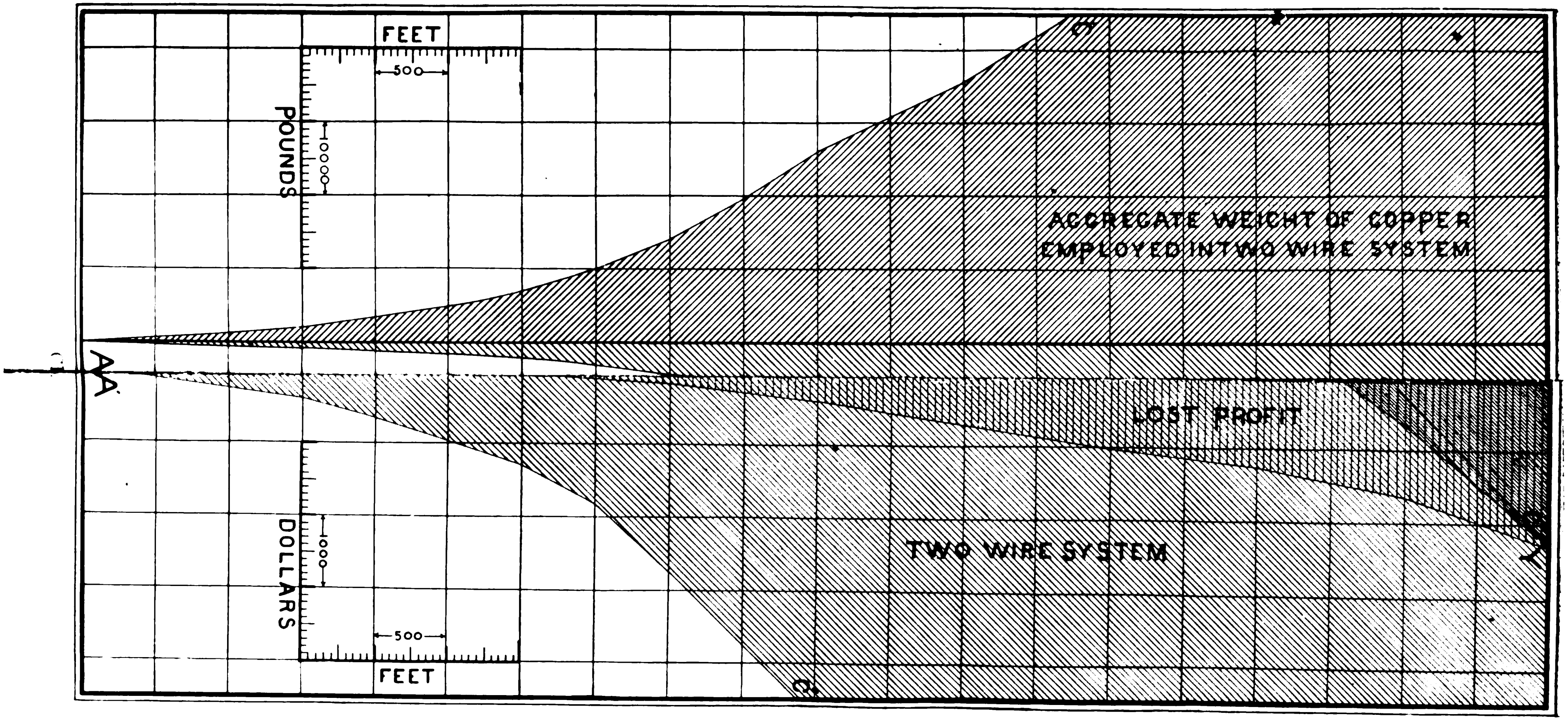
THE TRIUMPH ELECTRIC CO., Cincinnati, Ohio, call attention to the details of construction of their dynamos and motors.

A MODEL SWITCHBOARD is the title of the Wagner Electric Mfg. Co.'s "ad" and in it they illustrate one they built for the Missouri Edison Co., of St. Louis, whose plant is described at length in this issue.

THE DETROIT COPPER AND BRASS ROLLING MILLS, Detroit, Mich., are manufacturers of bore copper wire, sheet copper, brass, bronze and German silver, brass wire and rod, brazed tubing, rivets, etc.

CONTENTS.

Department News Items will be found in advertising pages.


ACCREGATE WEIGHT OF COPPER
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The Electrical Engineer.

Vol. XXV. JUNE 16, 1898. No. 528.

ELECTRIC LIGHTING

General Distribution From Central Stations by Alternating Currents.[1]

BY HERBERT A. WAGNER.

EVER since the installation of the first few pioneer alternating-current central stations, just 10 years ago, we have heard it predicted with persistent reiteration that for the distribution of current for lighting from central stations direct current was a thing of the past, and that in a few years the alternating-current transformer system would hold the field without a competitor.

To many, this prediction may seem to have been fulfilled, considering the enormous number of alternating-current plants, compared with direct current, that have been installed, and the remarkable impetus given to electrical industries by the development of alternating currents.

The great success achieved in the transmission of power by polyphase alternating currents in the last three years has but strengthened this general belief, and left fewer champions to adhere to the direct-current cause.

These great achievements, I say, have led the enthusiast to think all progress confined to alternating systems of distribution. Deeper investigation, however, shows that while in point of number the alternating-current stations, reaching into the thousands, completely overshadow those of direct-current, there are few really large stations, outside of water-power plants, that are to-day employing alternating currents for distribution, and

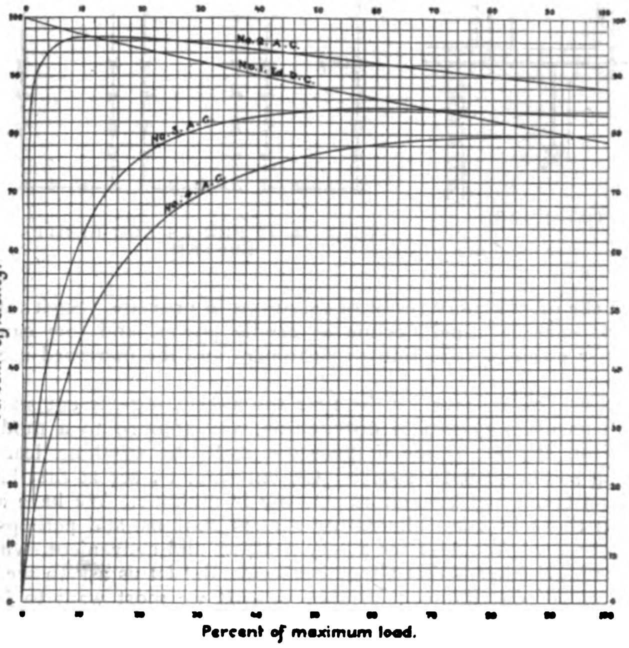


FIG. 1.—CURVES OF DISTRIBUTION EFFICIENCY.

that while enormous investments have been made in direct-current stations in our larger cities, comparatively small amounts have been invested in alternating-current work.

The alternating system was heralded as providing a means of distribution with a great reduction in first cost of plant, and for years the development of the system has been made with this the principal end in view. On the other hand, direct-current distribution in the form of the Edison three-wire system has been steadily and intelligently developed to the highest standard of economy of operation, simplicity and permanence. In the same city, alternating-current stations have not, as a rule, been successful in competition with three-wire stations; their service has not been as good, and their profits have been smaller.

I may startle many by stating frankly the discouraging fact, which has been barely whispered at times, that, judged by the standards of the magnificent Edison properties in many of our larger cities, few alternating-current central stations in the United States have been a success. Do not imagine that this damaging admission, however, is an indication of any loss of faith on the part of one who has been identified with alternating-current work since its début, as it were. Far from it. The fault lies, not with the alternating current itself, but with its application. Its few apparently inherent deficiencies, such as the difficulties of operating motors and arc lamps, have been shown to have been only awaiting discovery and development, and were at our disposal almost as soon as these important divisions of central-station service were operated with success from the Edison three-wire system. These can, therefore, hardly be held responsible for the difference in the commercial results obtained with the two systems.

As I have said, the ends in view in the development of the two systems have been radically different. The one was to produce a given amount of light for the minimum of investment; the other was to provide a permanent investment that would render the maximum of profit. These standpoints in general mark the difference between the manufacturer and the user, and we find these two systems developed in this way—one almost entirely by the manufacturer, and the other by the combined efforts of the various users. The results are the natural effects of progression along these lines.

Few opportunities have we had of comparing the two systems from the same standpoint and under like conditions. The purpose of this paper is to show the alternating current applied from the same standpoint, compelled to fulfil the same conditions, and then to compare the results with the best produced with direct current.

To better contrast the different methods of distribution, we will review briefly those in general use before describing the most recent developments.

The early alternating-current stations were installed on the principle that the drop in lines with distribution at 1,000 volts was so small that it was practically negligible. Two wires were accordingly run out from the station, passing along those streets where light was to be furnished, and lights were connected ad libitum at any desired points between the station and the farthest end, without reference to such trifling considerations as difference in potential. Distribution was attempted in this way for years, and in many places is still in operation. Lines are even being constructed to-day without any notion of a system of feeders and mains, although an almost perfect system for the maintenance of uniform pressure was in operation in many Edison stations before the first alternating station was in existence. Fortunately for the operators of such models of simplicity, the current delivered has usually been so small in quantity that with the proverbial No. 6 wire, which seemed to posses virtues not affected by distances, the difference of pressure between neighboring customers rarely exceeded 10 per cent.

A few more enlightened experts—plants were always installed by experts in the early days—eventually conceived the novel idea that if the drop, a little of which they had discovered by that time, could be confined to a greater extent to those portions of the lines where there were no lights, some might be spared from the lighting districts. A few feeder lines were therefore stuck in here and there to boost up the pressure where it was lowest.

The regulation was all effected by means of the dynamo field rheostat, and the pressure indicated by a voltmeter on the secondary of a transformer whose primary was connected to the bus-bars on the switchboard. A few lamps were also operated by the same transformer to light the switchboard or other parts of the station. The station attendant was, of course, in absolute ignorance of the pressure at any point on the lines where lamps were used. The pressure was therefore usually run high enough to be on the safe side. The attendant was sometimes instructed to let his voltmeter needle follow gently the maneuvers of his ammeter, as there was thought to be a more or less intimate

[1] A paper read before the Nat. Elec. Light Ass'n, Chicago, June, 1898.

connection between volts and amperes and the volts ought not to be allowed to get too far behind.

If anyone ever breathed a suggestion of pressure wires, it was probably his last breath. At any rate, he was never heard of again. What! pressure wires with alternating current? Preposterous idea! Alternating and progression were considered almost synonymous terms. Antiquated ideas must be abandoned.

This faintly-whispered need might, however, be heard again, so, to meet the emergency, a compensating voltmeter was produced that could be adjusted for any drop in the lines. It was ingeniously arranged so that a small series transformer in the main line would send currents opposing those operating the voltmeter, thereby making the needle or index drop back approximately proportionately to the current in the line. This device was a great help, and caused the drop in lines to jump into prominence at once. It would be quite perfect if the drop in alternating-current lines were proportional to the current, but it is not. The power factor of ordinary alternating-current systems is usually quite low at light loads, and, except with very small wire, an ampere may therefore produce much more drop proportionately at light load than at heavy load.

One alternating-current station of which I have intimate knowledge has used pressure wires in connection with each feeder for years. There may be a few others, but they are rare exceptions even to-day.

ing for these transformer stations, together with the investment in instruments and switches required, and the attendants' wages, there is very much saving effected. Had we nothing better to turn to than these systems, the cost of distribution from large stations would be extreme compared with the direct-current, Edison three-wire system, and competition with the latter could not be a success.

Another very important consideration is the economy or efficiency of lamps used. To employ successfully the highest-economy lamp made, a very uniform pressure must be maintained. With the usual alternating-current system, and with an equally good disposition of feeders and mains, the variations of pressure will exceed those in a direct-current system by nearly 3 per cent., on account of the transformer drop, and to secure even this limit of variation, pressure wires must be used with each feeder.

It is not surprising to find, therefore, that almost all alternating-current stations are using lamps requiring 20 per cent. more current than those used by direct-current stations.

I cannot refrain from remarking here that to operate any station, alternating or direct-current, without pressure wires, is to be worse than penny-wise and pound-foolish. In any alternating-current station employing overhead wires, the saving in lamp renewals would equal the cost of pressure wires in little over a month's time. I might also add that the total loss of lamps is

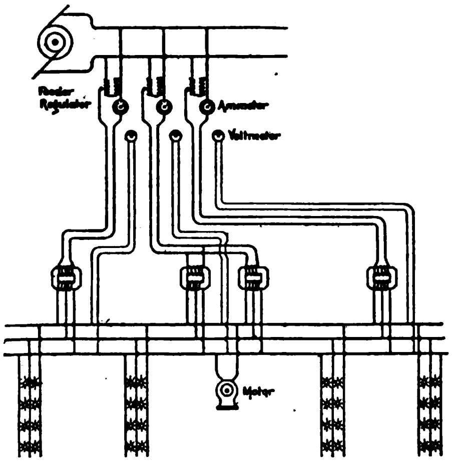


FIG. 2.—SINGLE PHASE A. C. SYSTEM.
With high pressure feeders and low pressure distribution. Independent feeder for each transformer or group.

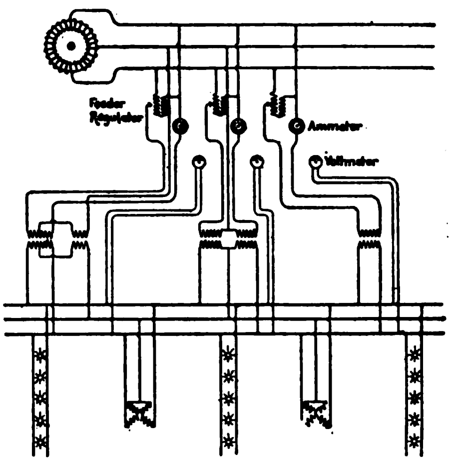


FIG. 3.—THREE-WIRE TWO-PHASE SYSTEM.
With single phase lighting. High pressure feeders and low pressure distribution.

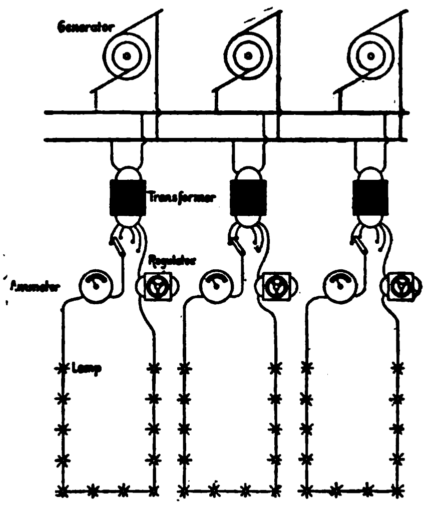


FIG. 4.—A. C. SERIES ARC LIGHT SYSTEM.

The usual system of distribution provides a separate transformer for each customer. In many cases, this implies the use of a very small transformer. It is impossible to make the efficiency of small transformers high. As each customer may at times use all of his lamps, he must have full transformer capacity for such an emergency. The ordinary ratio between maximum station loads and the number of lamps connected, is in most cases under 50 per cent. where meters are employed. The transformers then being of a total capacity equal to the number of lamps connected, average at best only 50 per cent. of their rated capacity at the maximum station load. In most stations the average load generated is much less than 25 per cent. of the maximum load, and, therefore, with twice the transformer capacity of that represented by maximum station load, the average transformer load would not exceed 10 per cent. of the transformer capacity, all the year round.

The efficiency of the average modern transformer of usual size at 10 per cent. of its rated load is not over 65 per cent., and the average of transformers at present in use not more than 50 per cent. It is perfectly safe to say that there is not an alternating-current station to-day using individual transformers for each or neighboring customers that can show an average efficiency of distribution of over 60 per cent., and few that can show over 50 per cent.

In Europe, it is, to some extent, the practice to use transformer sub-stations with low-potential distribution from these points. Transformers are cut in and out at these sub-stations by attendants according to the demand for current. It is doubtful if, after paying interest on the investment in property and hous-

not the most serious result of variations in pressure. Such variations cause a rapid decline in candle power, and low candle power means disaffection of customers and the increased use of gas.

Now, let us leave for the time the alternating-current station and its usual system of distribution, and adjourn to a modern Edison station, to see if there can really be anything learned from so antiquated a source. On entering, we see at first large direct-connected generators running in multiple. We have also seen those in a few alternating-current stations, and perhaps of larger size. We next see a very compact and convenient switchboard. Neither is that altogether new. But let us ask to see the system of distribution; for that is what we most want to look into.

On the plans of this system of distribution a remarkable network of feeders and mains is laid before us, most carefully calculated for the maintenance of uniform pressure. Means for regulating more or less independently the pressure on each feeder are provided. From numerous points in the system, corresponding to the feeder terminals, pressure wires are brought to the station, and indicators show the pressure at all these points. Numerous devices and appliances are shown us which must have been the result of years of experience in the development of distribution methods. We look with admiration, and ask why, with this apparently far more perfect system in existence, have we been working so long to try to perfect a new system that cannot to-day, we are informed, produce such results. Why, indeed!

But let us look a little further. What are those massive

beams? They do not seem to support anything. "Those are not beams. They are copper wires to carry the current out," we are told. "Wires? Why, they weigh tons!" "So they do, but they are necessary with this system." A very serious drawback, it would seem. Another question troubles us. Why do you occupy ground in a part of the city where property must be very valuable? Why do you not go off to one side where land is cheap? "Oh, we are forced to be near our centre of business. If we were twice as far away we should have to use four times the amount of copper in those bars." This, indeed, seems a very great defect. But are there no other defects in your system? In answer, we are told that there are no others that are considered serious.

If this necessity for using such an enormous amount of copper is the weak point of a beautifully developed system, why do we not endeavor to overcome that particular point and adopt the rest, instead of starting out anew and alone to develop another system from beginning to end? This is the question that should have been considered years ago. Why did we not start where others left off, engraft our alternating current and draw energy and strength from the old roots, instead of trying to grow from the seed to find ourselves running to limbs and branches with very little trunk to speak of. We have tried to overreach our older brother, and now lack his sturdiness and stability.

It is not too late, however, to begin afresh. We are satisfied that at the present time the Edison three-wire system of distribution is the most efficient in use and the most nearly perfect in details. We know that the usual system employed with alternating current is not efficient, and does not admit of as close regulation, but it is vastly cheaper to install.

Comparing the cost of individual transformers and high-potential distributing mains with the three-wire system of mains at low potential, we do not find a great difference in first cost in favor of the alternating. We do find, however, that the Edison feeders for the same distance cost about thirty-one times as much as for alternating current at 1,100 volts, 125 times as much at 2,200 volts, or 500 times as much at 4,400 volts. It would then appear that if we could apply alternating current to the feeders at high potential and transform down for the mains, we might reach the lower first cost of the ordinary alternating-current system and possibly retain all the best features of the direct current. To accomplish the former, the transformers must be provided at a small proportion of the cost of the alternating-current feeder, and to do the latter, they must not increase the average losses in the system. It is obvious that we could with alternating current move our station to any reasonable distance from our centre of distribution and at comparatively small additional cost for feeders. The whole problem then seems to come down to transformer efficiency and means of regulation.

To consider the matter of regulation first. We see at a glance that we cannot use the direct-current method of regulation by supplementary bus-bars, but we can use the booster method, and can, moreover, apply a static booster to each feeder to regulate within any desired limits and with as small gradations as necessary. In fact, the booster method of regulation was first applied to alternating-current distribution, and operates with much less average consumption of energy than either the supplementary 'bus or direct-current booster method. In this important consideration, we can therefore improve on and simplify direct-current methods.

The means of regulation having been in this way provided for the feeders, it remains to be considered what we shall do to eliminate the effects of transformer drop. As we have determined on a secondary low-potential, three-wire distributing system of mains, we can altogether dispense with high-potential mains and limit the high potential to the feeders. If we do this, we can conveniently have the transformers of the same unit capacity as the feeders, and arrange each with its primary connected to its independent feeder and its secondary feeding into the three-wire mains. We know that the effects of our feeder drop are eliminated if we regulate by pressure wires from the feeder ends. In the same way the effect of our transformer drop may be eliminated by bringing pressure wires from the secondary terminals. The feeder drop and transformer drop therefore become one, and are cared for in the same way. We can even secure better general regulation than with the direct-current system, as we have a better form of feeder regulator and have eliminated the effects of transformer drop.

Now, to return to the transformer itself and its efficiency. It is evident that, with this system, the transformer capacity need be no greater than that required for maximum station load, instead of more than twice that amount or nearly equal to that required for the total number of lamps connected. This at once doubles the average load on our transformers, and raises the average efficiency. It also incidentally reduces the first cost of transformers in still greater proportion. We also know, however, that transformer efficiency at light loads is dependent on the iron loss, and that this is interdependent with the regulation or drop. If we can increase the drop, we can decrease the iron loss, and thereby greatly increase the average efficiency. Having provided against any interference with the regulation of the system by the transformer drop, we can afford to increase that to the heating limit of the copper. In this way, a 100-kilowatt transformer can be built with an average efficiency of over 98 per cent. The entire transformer loss can, moreover, be more than made up by the less loss in feeders, which we would naturally have with alternating current.

We have thus eliminated the two features in which the ordinary alternating-current system of distribution has been inferior to the direct-current, and have provided means for obtaining better regulation and higher efficiency at a very much less cost of installation than with the direct-current system.

This system was conceived several years ago, and it has since been my good fortune to have an opportunity to install a system of this kind on a large scale, which is now in very satisfactory operation. It is laid out exactly as a three-wire Edison system would be, except that there are no sub-feeders. A network of mains is planned as if for use with direct current. The feeders are all designed for 110-kilowatt maximum load at 1,100 volts, and at each feeder end is placed a 110-kilowatt transformer feeding into the three-wire network in the same manner and at the same points as with the direct-current system. The transformers are located in manholes of suitable design. From the secondary terminals of each transformer, pressure wires are run back to the station. Each feeder has an independent regulator by which the pressure can be raised or lowered. There are no primary mains, nor any connection whatever between the primary feeders. The regulators perform two functions. They are used to maintain the proper pressure as indicated by the voltmeters and also to divide the load between transformers in any way desired as indicated by the feeder ammeters. It is possible to shift the entire load from one transformer and feeder to an adjacent transformer in this way without sensibly affecting the pressure on the system, and an equal division of load between transformers can be readily maintained at all times if desired. This is a very important consideration when very heavy loads or overloads are to be carried. The distribution of load on any large system is constantly changing as new customers are connected, and in large Edison stations certain feeders often become so overloaded that it is found necessary for their safety to put resistance in series with them to force some of the current to other feeders. The possibility of overloading any individual feeder beyond its share is absolutely provided against in the system described. To make the arrangement of this system perfectly clear it is illustrated diagrammatically in Fig. 2.

In Fig. 1 are shown four curves of station distribution efficiency. No. 1 is that of a representative Edison three-wire, direct-current station. No. 2 is the new alternating-current system described. No. 3 is the usual alternating-current system employing separate transformers for each customer or for adjacent customers, the best modern transformers being used. No. 4 shows the same system, but with the average transformers found on the lines of most existing stations. These curves were plotted from the following data obtained from actual practice:

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent.
Feeder loss	24	8	10	10
Main loss	2	2	2	2
House wiring loss	1	1	1	1
Transformer loss, iron		.23	6	12
Transformer loss, copper		2.7	1	.5
Total loss at maximum station load,	27	13.93	20	25.5
Efficiency at maximum station load,	78.7	87.9	83.3	79.6

The efficiencies of distribution at assumed average loads are shown to be as follows:

Per cent.	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.	No. 4. Per cent.
Load, 25	94.1	95.8	78.4	66.6
Load, 20	94.8	96.2	75.3	61.4
Load, 15	96.1	96.5	70.3	54.3
Load, 10	97.3	96.4	61.9	45.1

At maximum load it will be noticed that the efficiency of alternating-current No. 2 is 10 per cent. higher than No. 1, the direct current. This means that the same energy can be delivered with 10 per cent. less capacity in generators, engines and boilers, or a difference of 10 per cent. in the first cost of generating plant. It is pertinent to remark here that alternating-current generators also have a much greater margin for overload for short periods than direct-current generators. The efficiency at average load, or the all-day efficiency of the No. 2 alternating-current system is also shown to be appreciatively higher than the direct-current. In large central stations the average load is generally found in practice to vary from about 15 to 20 per cent. of the maximum, and it will be noted that from 12 per cent. average load up, No. 2 curve for the special system of alternating-current distribution shows a higher efficiency than the direct current.

It may be asked what effect the aging or fatigue of the transformer iron will have on these figures. I answer, none appreciable. Transformer manufacturers are willing to guarantee as low as 1 per cent. increase per year in iron loss. This means 1 per cent. of the actual amount of energy lost in the iron, so that, if this increase continued at the same rate, it would take 100 years to double the iron loss. Experiments tend to show, however, that this effect rapidly approaches a maximum and that therefore the increase goes on at a constantly decreasing rate. The entire effect may be eliminated, if desired, about once in five years by reannealing the transformer iron at a very small expense.

It has been the practice in some European stations to cut out transformers during periods of light load, but it will be seen that cutting out transformers in the system described would only decrease the efficiency; in fact, the efficiency is higher at about the average load, and the system was designed throughout to accomplish this result.

The less we say about curves Nos. 3 and 4 the better, as at small loads the efficiency is shown to be appallingly low.

EXTENSIONS OF DIRECT CURRENT SYSTEM BY ALTERNATING CURRENT.

Several large three-wire, direct-current Edison stations are beginning to employ alternating current to extend their lighting territory beyond that possible or profitable with low-tension current. This is a recognition of alternating current which would not have been considered for a moment a few years ago. They now propose to use alternating current to transmit their energy at high potential to a distant sub-station, where it will be transformed to a lower pressure and then again transformed by means of rotary transformers to direct current, which is in turn distributed over the three-wire Edison system as if generated in the ordinary way. This is a very beautiful and instructive application of alternating currents, and ingeniously designed machinery. It gives the manufacturers a chance to sell additional machinery, swells the company's real estate investment and gives work to the unemployed to operate the substations.

The loss is in the conversion to alternating current and back is about 15 per cent. in addition to the loss in static transformers and lines. This distribution might be accomplished without the additional machinery, wire, real estate, labor and loss in efficiency. It is hardly to be expected, however, that those who have grown up under the protection or influence of direct current would use alternating current any further than absolutely necessary until they have grown more accustomed to the new mode of travel. After looking across the stream to coveted territory for many years, they are willing to use the new bridge and to ride across at about the highest speed provided, but when they get on the other side they are more than satisfied to foot it again the rest of the way.

A much higher efficiency of distribution, and better regulation could be secured by using the alternating-current system as it is, without transformation to direct-current, and everything could be controlled from the main station without employing labor or apparatus at sub-stations. Why do they not use it so? They say that many things cannot be accomplished as well with alternating current. If that is a challenge, we will accept it and try conclusions with them. Let us then anticipate these various objections and see what they amount to.

FIRST, EFFICIENCY.

We have already seen how a properly designed system of distribution for alternating currents may be made to exceed the direct-current system in efficiency, taking the latter under its most favorable conditions. If we then add to the usual losses in the direct-current system the losses in double rotary transformation and in static transformers, the very great difference in favor of the alternating current is still more marked.

REGULATION.

It has been shown how very simple and reliable regulators can be provided for each alternating-current feeder, which will secure the closest possible regulation over any range desired, and this can be effected at a loss of less than 1 per cent. Such close regulation can only be secured with direct current by the use of a number of generators connected to auxiliary bus-bars, or by connecting the feeder ends to adjustable resistance connected between the 'busses of two or more generators. The first cannot be realized in a rotary-transformer station, and the last is quite wasteful of energy. Regulators placed on the alternating-current feeders of the rotary transformers control alike the pressure on each rotary, and all the direct-current feeders supplied by the same, in exactly the same way as field regulation does on a direct-current generator. Such regulation can only be effectual with a number of small rotaries not operated in multiple. The best regulation can, therefore, undoubtedly be secured with the alternating-current system.

OPERATION OF ARC LAMPS.

It seems now to be the universal opinion among Edison station men that the enclosed-arc, long-burning lamp is destined to replace all the old forms of arc lamp. We will, therefore, consider this type of lamp only. Fully as well-burning lamps of this type are now made for alternating current. They are also about as free from noise as the direct-current lamps. Many will say, however, that it is impossible to get as much light from the alternating current as from direct current. That is true if we state that the same energy in the arc produces less light with alternating current than with direct current. It has been determined that the alternating-current arc produces about 70 per cent. of the light to be obtained from the same number of watts in the direct-current arc. The usual direct-current enclosed arc requires 5 amperes at 115 volts, or 575 watts. How much of this is used in the arc? Somewhat less than 80 volts, or under 400 watts; the balance of over 175 watts being wasted in resistance.

With alternating current, 70 per cent. of the amount of light would be obtained with this 400 watts, or about 570 watts would be required to produce the same light. The alternating-current arc is best operated at about 70 volts, but inductive resistance is used to bring the pressure down to this amount. This inductive resistance consumes about 10 watts actual energy, making in all 580 watts, against 575 for the direct current for the same amount of light. This difference of 5 watts, or less than 1 per cent., is insignificant.

The standard alternating-current enclosed arc consumes about 420 watts at the lamp terminals, but I have had made to order a large number of 550-watt lamps, which have replaced many series 10-ampere direct-current lamps. There are certain kinds of arc lighting to which the alternating current is particularly well adapted, of which I will speak later on.

MOTORS.

The greatest argument used against alternating current used to be that it would not run a motor. It has long ago proved that it can, and that without a commutator. This subject now brings us to multiphase systems. There are two of these systems in general use, the two-phase and the three-phase. Other systems are but modifications of these and will be mentioned as such. Motors can be operated with equal facility and efficiency on either system and have many distinct advantages over direct-current motors.

For long-distance power transmission the three-phase system shows an economy in copper; but for lighting, or for lighting and power combined, it is not at all well suited. I might say that where lighting is a distinct feature, and first-class service is to be rendered from a large station, the three-phase system cannot be used successfully. On even the best generators the windings are so entirely independent that a change of load on one phase will affect the pressure on the other two; but a defect even worse is the impossibility of regulating the phases independently for drop in the feeders if the load happens to vary differently on any two. Any regulator placed in circuit with one phase will effect about the same change of pressure in the adjacent phase within the usual limits of regulation. Regulation

is then a question of the best possible averages, and at best is but guesswork. With the feeder and transformer drops found economical in practice, it would be practically impossible to keep the pressure sufficiently constant for high-efficiency lamps. The complication of wiring is also very serious, especially if the Edison three-wire system is used for distribution, as six wires would then be required, forming six circuits that must be kept balanced.

The two-phase system is subject to the same objections unless the two phases are used separately for lighting, in which case we have the complication equivalent to twice the number of generators and feeders.

For good regulation and simplicity, the single-phase system cannot be equaled by any multiphase system.

The so-called monocyclic system is a modified two-phase system in which current is distributed for lighting on a single-phase circuit only, and a third wire carries current in quadrature to the first, which, in connection with the first, is transformed to a three-phase relation wherever it is desired to operate motors. The regulation of this system can be made almost as good for lighting as the single-phase, and can be as simply affected. The third wire adds complication, but no balancing is required, as all the lighting is done from single phase on two wires. If low-tension, three-wire distribution is attempted with this system, a fourth wire must be used for power distribution.

A system practically the counterpart of the monocyclic is the three-wire, two-phase system, in which the lighting is all done on one single-phase, and a third wire is used in conjunction with the other two for power. It is handled in exactly the same manner as the monocyclic system, the only practical difference being in the relative potential of the quarter-phase circuit. In the monocyclic, the quarter-phase element of the generator winding is one-quarter the potential of the main winding, giving between the power line and the main lines a pressure of 55 per cent. of that between the main lines themselves. In the special form of three-wire, two-phase, the quarter-phase element of the generator winding is equivalent to one-half of the main winding, which causes a pressure between power line and main lines 71 per cent. of that between the main lines. For power distribution, this system requires slightly less wire than the monocyclic. Fig. 3 shows diagrammatically the arrangement of this system used in connection with the special method of distribution already described. The diagram shows a system of two-wire mains for lighting to which might be applied, of course, the Edison three-wire system. The motors used would most naturally be of the two-phase type, although three-phase motors may be used with equal facility by the method of transformer connections devised by Mr. Scott.

It can be readily seen that while these systems are much better adapted to general station distribution than the two-phase or three-phase, they will lack the simplicity of the single-phase, and both require more wire. Fortunately, we can now obtain single-phase motors which equal the multiphase and direct-current motors in efficiency and all most desirable points. They start readily with load and may be operated with variable speed; in fact, they equal the direct-current shunt motor in all points, excelling it in efficiency and simplicity.

We can meet the direct-current advocates on the power question, therefore, on at least an equal footing, save only one application met in central-station practice, namely, the operation of high-speed elevators. The alternating-current motor, multiphase or single-phase, cannot be controlled for this work as readily as a compound series, direct-current motor. It has taken several years, however, to perfect the mechanism for the control of direct-current elevator motors. Give us the same time and we will do it with alternating current. This field for power has only of late been opened to direct-current stations, and it is yet a question for debate as to whether it is a paying one.

SPECIAL APPLICATIONS OF CURRENT.

There are many special applications of current met with in practice, most of them bringing a small return, such as electroplating, electro-cautery, charging small storage batteries, electric heating and cooking, etc. The first three require low-potential currents and are economically effected only by motor generators or rotary transformers. It is evident that this transformation can be accomplished as readily with alternating current as with direct current. Electric heating and cooking are as yet luxuries and cannot be depended on for much revenue. They can be done with equal facility by alternating current.

STORAGE BATTERIES.

Here we come to the direct-current advocate's last and greatest stronghold. To this he retreats with great confidence of safety. We may ask first whether storage batteries have yet been proved to be a valuable adjunct to the central station, cost and maintenance considered. It is true they are being tried by several large stations, and we watch eagerly for the results. They equalize the station load to a greater or less degree, and cut down the generator capacity for the peak. Are they, however, cheaper than generators, engines and boilers of the same capacity? Are the losses in transformation less than the cost of a few more attendants? Is their maintenance less expensive than that of generating apparatus? These questions cannot as yet be answered in the affirmative. But if the battery man's most sanguine hopes be realized, what then? If rotary transformers are good enough for the direct-current man to use to change the direct current to alternating current, transmit a good proportion of his load to a distance and transform again to direct current, why should not the alternating-current man use them to charge his batteries and then to transform their output back to his pet form of current? Loss in transformation, do we hear some one say? Not any more than with our contemporaries' long-distance transmission system, and, in this instance, they are small and unimportant, we are told. There is at least one station in the country where storage batteries are being used in this way, and I believe with success, as storage batteries go.

Have our direct-current friends anything more to bring forward? Or have we forced their last position? Well, we will declare a truce, and acknowledge that they fight bravely. We have learned as much from them as they can learn from us. If we had been as quick to acknowledge their beautifully designed distributing details and applications as they have been to appreciate a few of the advantages of our current, we might have been nearer together, or even hand in hand, long ago. As it is, we are both working to the same end, and our paths must join sooner or later as they converge.

Before closing, I wish to recapitulate a little, and draw your attention more forcibly to the flexibility of the alternating-current system. We all know of the many applications to which this current is now put, and what we have described here is, most of it, not new to many of us. The use of the rotary transformer has been widely talked of and described for the last two years. The facility of operating lines at any potential desired, through the means of step-up and down transformers is no longer an experiment. Multiphase motors are familiar to all, while single-phase motors have been much talked of and written about, and failures have, time and again, followed boasted success. Many of us, however, have within the last year seen them quietly at work, thoroughly tamed and domesticated. One large station is using them extensively, and is so thoroughly convinced of their success that it has discarded all notion of using multiphase distribution, although it is using generators that can be operated two-phase if desired. Direct-current motors are being rapidly replaced by these single-phase motors to secure uniformity of system.

Arc lamps have been familiar to us on alternating-current circuits for some time, and the alternating current, enclosed, long-burning arcs are now numbered by the thousands. Street lighting is still, however, in most places done on the direct-current series system, and even the largest machines yet built for this purpose are very small in comparison with our large direct-connected generators.

The great desideratum in central-station practice is to be able to employ one system for everything. All current for all classes of service should be supplied from but one generator, be this direct current or alternating current. In this way, only, can the maximum output be accomplished from a given investment in machinery and apparatus, and the greatest economy in operation secured. This has been accomplished in many stations where a limited range of service is to be provided. Arc lighting has, of all, been the most troublesome to provide for. How shall we operate our arc lamps from our incandescent lighting system, has been the anxious inquiry. The constant-potential arc lamp has answered this question for commercial lighting, but city street lighting cannot be so easily provided for. The Edison companies have done a limited amount of this from their three-wire system, but this can be done to advantage only in districts where mains have been provided for commercial lighting.

For extended arc lighting, the small series machine with its belts and clutch pulleys still holds the fort.

I am able to state, however, that one large company has recently solved the problem to its entire satisfaction. This company furnishes 2,600 street lamps to the city, lighting some 300 miles of street. These were operated by a small army of series arc machines. They were installed by a company that was acquired by purchase by the one first mentioned. As this company had long since adopted alternating current for its entire distribution, it was extremely desirable to be able to operate these city lamps from its large direct-connected alternators, thereby saving in fuel, attendance, floor space and reserve investment.

After a few months' trial of an experimental circuit with alternating current, it was found perfectly feasible to operate the same direct-current lamps, slightly remodeled, on the same circuits of 60 or 80 lamps in series. A system of this kind was therefore adopted and the company now has 2,300 of these lamps in regular operation by alternating current in this way. The circuits are each provided at the station with a regular step-up transformer of a maximum capacity of 4,000 volts and 10 amperes, and the feeders to these transformers are treated on the switchboard in the same way as the feeders for incandescent lighting. It is quite usual for one generator to carry 2,000 of these lamps. The lighting is satisfactory to the city and the lamps give better service than when operated by direct current. There has been a very marked saving in fuel and attendance. The indicated horse-power per arc lamp is considerably less than with the direct-current arc lamps operated in the usual manner. Fig. 4 shows this system in diagram.

I know of no other place where this is being done, and it stands as a very pronounced example of the flexibility and adaptability of alternating currents.

There have been a great many problems in the operation of large alternating-current stations that have been discouragingly difficult of solution. The handling of high potentials on switchboards, the operation of generators in multiple, with facility, and scores of more or less important difficulties have, one by one, been surmounted, the burden of the work usually falling on a few of the pioneer stations.

In summing up, we find the following marked features in which the alternating current, properly installed, has been shown to have pronounced superiority over the direct current:

Highest possible efficiency of distribution and operation.

Best regulation.

Largest territory desired readily supplied from one station.

Comparatively small cost of feeders, effecting enormous saving in investment.

Least cost of real estate.

Cost of installing and operating sub-stations entirely void.

The only system in which all classes of service can be supplied from one type of generator.

Greatest flexibility.

In closing, I wish to thank my friends and co-laborers of the direct-current faith, from several of whom I have had the pleasure of learning much that has proved of great value to me.

Induction Motors in Bleach and Dye Works.

The Westinghouse induction motors (type "C") are everywhere demonstrating their usefulness in new fields. Some two years since, the Westinghouse Company installed for the Silver Spring Bleaching and Dyeing Co., of Providence, R. I., a complete plant for power purposes, and the growth of the business since that time has recently called for an equipment of fifteen type "C" induction motors of the latest type.

The conditions of service are very severe indeed, many of the motors operating continuously in clouds of steam or in the presence of chloride fumes which rapidly corrode all exposed copper parts. Some of these motors have to exert four times the normal torque in starting ironing machines or calendars full of heavy gearing, etc.

The installation, which was regarded as a risky experiment when first contemplated, has proven a most pronounced success.

DeVEAU & COMPANY have had an order from the Government for 57 submarine telephones for the use of divers.

Presidential Address; Chicago N. E. L. A. Convention.[1]

BY SAMUEL INSULL.

IN calling to order the annual convention of your Association my dual capacity presents somewhat of an embarrassment to me. I am in doubt whether as president to enlarge upon the great growth of this Association since its formation in this city on February 25, 1885, or whether as a resident here to dwell at length upon the marvelous growth of the city in which we meet. Chicago and the industry with which we are identified have a somewhat close connection. The growth of the former, if measured from the point of view of the rapidity with which history is made, is, so to speak, the product of yesterday. The electrical industry, or rather that portion of it with which we are associated, is but little more than the product of to-day. If the growth of this city and that of our own industry is as great during the next thirteen years as the progress that they have achieved since the date of your first meeting here, I am sure that both the citizens of Chicago and the members of your Association will have every reason to congratulate themselves. Speaking for those of my friends connected with the electrical industry in Chicago, and also for myself, I can assure you that it affords us very great pleasure to welcome you at this convention, and the fact of your meeting in this, my home city, enhances not a little my high appreciation of the privilege of presiding on this occasion.

The officers of your Association have had in mind in preparing a program for this convention the importance of bringing before you subjects of interest in connection with central station management, and the papers to be read at our various sessions and the topics mentioned for discussion cover such a wide range that it would seem undesirable for me to occupy much of your time by way of introduction. The various gentlemen who have so kindly consented to read papers will deal with such important questions as the cost of generating and distributing the product which we manufacture, transformer economy and the rival claims of alternating currents and direct currents as means of distribution. The many problems which you have to solve in connection with the question of public lighting and the cost of producing electrical energy by water power, will also be discussed.

STANDARD VS. SPECIAL MACHINERY.

A matter which has called forth during the last year considerable discussion is the question of the use of standard apparatus and the tendency towards the specification of special machinery on the part of electrical engineers. This course is not by any means confined to large work, but is followed by some engineers whether they are designing a small isolated plant or are projecting a large modern central station. It would seem to me to be of paramount importance to the manufacturer and user that both should co-operate in eliminating as far as possible from the business the necessity of building and using special types of machinery. This can only be done by the adoption of standard specifications for various standard types of apparatus. A committee of the American Institute of Electrical Engineers has already taken this subject under consideration, and I believe that we will be serving alike the interests of the manufacturers and users of electrical apparatus if we will take some action with a view to co-operating with the Institute and other bodies in this matter. In drawing attention to this subject I speak with an appreciation of the position of both manufacturer and user, having had more or less connection with the manufacture of electric apparatus and the manufacture of electric current. Constant duplication of parts resulting in constant duplication of a given piece of machinery means, as any manufacturer will tell you, constant reduction in cost. Variation from a given type means increased cost and even the wiping out of an apparent profit. In the last year or so there has been a great deal of discussion in England prompted by the success of American manufacturers in obtaining large contracts for electric traction work in Great Britain, and the inquiry has often been made, how is it possible for American electrical manufacturers, with high wages against them, to compete with English builders, whose scale of pay to their workmen is on a very much lower basis. If you will examine into the amount of electric traction machinery manufactured in this country under a system of constant duplication and

[1]Delivered before the Nat. Elec. Light Assoc., Chicago, June 7, 1898.

the use of special tools, and then visit the electrical establishments on the other side of the water and note the tendency there towards specializing each particular job, you will soon recognize that the reason for low cost and consequently low selling price on this side of the ocean, is brought about by the fact that in America this class of work is largely designed by the manufacturer, and as a natural result is the duplicate of something already produced, whilst on the other side of the Atlantic the builder of the machinery works from the plans of the electrical engineer, which necessitates his producing something different to fill each different contract. In one case the machinery is really manufactured; in the other case the builder runs a jobbing shop. Unfortunately during the last few years American users of electrical apparatus have somewhat departed from the pursuance of what is really a fundamental principle of American manufacture, namely, the use of existing types which are turned out in large quantities with special tools with a view to the lowest possible cost of production. The electrical engineer for the purchaser has been permitted to draw up specifications which have tended towards the specializing of apparatus, necessarily interfering with rapid manufacture and low cost of the product. The disadvantage to the manufacturer is apparent. It is turning our large electrical works from manufacturing establishments into jobbing shops, cutting down their capacity, increasing their labor cost and lengthening the time that it takes to produce a given article. Looking at it, therefore, from the point of view of the manufacturer, the capacity of his plant is reduced and consequently his interest and general expense cost is higher; his labor cost is increased; and if he finds himself unable to increase his selling price, his shop must be run at a loss instead of at a profit.

The user is necessarily interested in low cost of production on the part of the manufacturer, as he cannot expect to purchase apparatus except at prices which yield a return to the maker. From this point of view alone it would seem to me to the interest of the user that he should co-operate with the manufacturer with a view to standardizing apparatus, eliminating unnecessary variations from a given type and providing specifications for machinery calling for a given capacity at a given efficiency. Such a course would lead to low cost of manufacture and consequently low selling price, coupled with rapid production.

Another objection to special apparatus is the expense and delay in obtaining duplicate parts in case of break-down. The fear of delay under such circumstances often necessitates the user carrying the duplication of his plant to a point entirely unnecessary when standard apparatus is used. Capital investment and consequently interest cost is thus increased, not only by the purchase of apparatus which of itself is expensive to build, but also by the duplication of investment which I have pointed out must of necessity follow.

A further point which should be borne in mind in connection with the lack of standard specifications is the opportunity that it gives to the unprincipled manufacturer to dispose of his second-rate apparatus to the uninitiated. We talk of a machine having a given capacity; but under what conditions should it operate to develop this capacity and how often does it occur that a dynamo machine is rated entirely too high and at the cost of its efficiency? How much miscellaneous material used in connection with the industry is absolutely unfitted for the purposes for which it is sold? Surely all of us, manufacturers and users, are interested in maintaining the highest possible standard of work and eliminating alike from our central station systems and the installations for our customers worthless appliances whose only recommendation is their apparent cheapness, whereas, as a matter of fact, they are really the most expensive that can be bought, because they are unfitted for the purposes for which they are intended. A proper consideration of this subject would not embrace alone the apparatus we are ourselves in the habit of buying for use in connection with our plants, but also the appliances used in connection with customers' house wiring. It should be borne in mind that faulty apparatus from one or more customers is, in the mind of the user of current, set down to the unreliability of the system as a whole. A central station customer seldom discriminates between a contractor who supplies a worthless device and a company supplying him with current. Standard specifications should therefore cover not alone the machinery used, but also the devices and material forming part of a customer's installation. This association has addressed itself at various times to the consideration of questions in connection with house wiring and has co-operated with the National Board of Fire Underwriters and other bodies with a view to establishing rules to be followed by contractors. I strongly recommend that this matter be taken up on a broader basis than heretofore, and that in conjunction with the technical societies we invite the co-operation of the electrical manufacturers with a view to standardizing apparatus and the specifications therefor, whether for use in the central station itself or in connection with the distributing system.

I do not want my remarks on this subject to be taken as in any way censuring the many electrical engineers who have by their special training and natural ability done so much to develop the industry with which we are connected. From my experience I am satisfied, however, that from the point of view of the user, the designing engineer who adapts his requirements to the standard apparatus of a first-class manufacturer, is able to produce a plant of more satisfactory character and more economical to operate than that designed by those engineers who I regret to say are sometimes influenced by the desire to use machinery which they can claim as their own handiwork rather than use something that would be quite as satisfactory and has the advantage of being the regular product of an established manufacturer.

The consideration of the subject of standard specifications would naturally include the preparation of specifications with relation to the manufacture of incandescent lamps. For several years past a committee of this Association has had this subject under consideration. It has been found practicable by a number of large central station companies connected with another association and buying from one manufacturer to purchase their lamps under specifications which provide for the testing of samples of the product of the factory, the payment for lamps supplied being based on the results of the tests. It seems to me that it would be possible to adopt standard specifications under which our members could purchase their lamps from any reputable lamp manufacturer. The importance of this matter will be appreciated when it is remembered that the cost of lamp renewals per unit of output exceeds $1.00 per ton of the cost of fuel in operating a central station, with the most modern steam plant.

SELLING PRICE BASED ON COST.

It is of prime importance to central station managers that they should sell the product they manufacture, namely, electric current, to the greatest number of consumers at the lowest possible price, and yet obtain a reasonable profit. For a number of years the basis of charge on the part of most companies has been a given unit price, with discounts for quantity. In the early days of the business some companies were in the habit of charging a fixed price per lamp per month, having no control whatever over the use of the product, but being necessarily responsible for the increased operating expenses caused by the wastefulness of customers, who could hardly be expected to economize, inasmuch as they paid exactly the same price for the use of light, whether they burned it one or twenty-four hours a day. A majority of these companies, however, following this last method realized at an early date the absurdity of distributing that for which they were not paid, and as a result I presume we can fairly assume that electric lighting business (with the exception of arc light service) is run almost universally on a meter basis. It is therefore unnecessary for us to discuss the question as to whether the measuring of current is a desirable thing in our business, as it is now generally recognized as a necessity. If you will make a careful examination of the factors entering into the cost of current you will very quickly come to a realization of the fact that interest is by far the most important single element, and that this item varies very considerably with the different classes of service furnished by a central station company. The interest factor in cost depends upon the yearly average consumption of your product by the customer; or, to put it another way, you can figure your interest on the basis of so much per unit of output at maximum load. For instance, take the two probably extreme classes of customers to whom the central station company supplies current for lighting purposes. On the one hand, you have an office building whose tenants only use artificial illumination for a very short space of time each day during the winter only. On the other

hand, you have a basement customer whose use of your product averages nearly one-half of the day of twenty-four hours during the whole year. Your investment, to take care of each of these customers is practically the same, therefore your total interest cost must be the same in both cases, but if you distribute this interest cost over the actual units consumed you will find that the tenant of the office building costs you for interest per unit of current sold many times more than does the occupant of the basement. There are of necessity as many different grades of customers between the two extremes I have mentioned as there are different classes of business and different characters of structures in which these businesses are conducted. Surely, if the cost of production varies according to the different conditions under which your customers use your product, it is but fair that the selling price per unit should vary correspondingly. If it does not, you, of necessity, encourage the use of electricity by customers whose business is unprofitable to you, and discourage the use of your product by customers whose business at a lower price would yield you a fair return. In past conventions the question of how to improve the day load for the purpose of raising the average output, what classes of business should be encouraged other than lighting to achieve this result, and the price at which we can afford to sell current to the operators of these different lines of business, have come up for discussion. At the last convention the realization of the fact that great differences exist in the elements governing the cost of product for different classes of lighting customers,. was ably presented by Mr. Arthur Wright, and he pointed out that the improvement of your load factor, the broadening of your curve and the rendering less acute of your peak is a matter within your own adjustment, providing that you will realize in considering cost with a view to making a selling price, that conditions are so dissimilar that the expense to you per unit of supplying two customers in the same block is likely to be widely different. Various plans have been adopted by a comparatively small number of companies to meet the conditions as we now know them to exist. Some companies have adopted the scheme of allowing certain special discounts providing the income per month per lamp connected exceeds a certain amount. Other companies charge one rate for current used during certain specified hours of the day and a much lower rate for the current used during the remaining hours of the dav. A third method is a system of discounts based upon the total consumption of current during a given period, considered in connection with the maximum consumption at any time during that same period.

These various methods all have the same object in view, namely, the meeting of the conditions of each individual customer, and yet at the same time earning a fair return on all of the investment provided for all of your customers.

In discussing this matter I have referred alone to interest cost because it forms so large a proportion of the total cost, but you will find that this same principle enters into a number of the other elements which go to make up your total cost. It would therefore appear to me that in considering the cost of generating electricity you should bear in mind that a large proportion of the items which go to make up the total are within your own control, and their amount per unit of output depends very largely upon the methods adopted in selling your product.

PUBLIC CONTROL AND PRIVATE OPERATION.

A subject of growing importance to a number of our members is the question of the public ownership and operation of the undertakings now operated by electric lighting companies. The agitation in connection with this subject has called forth a great deal of discussion, partly by those interested in it simply with a view to extending the influence of political parties, and partly by serious disinterested thinkers who believe that the best interests of the greatest number are to be obtained by the creation of a municipal socialism, which, if carried to its logical conclusion, must ultimately result in municipalities performing with others, such public service work as we are engaged in, and also in producing the food we eat and the clothes we wear. To those occupied in the management of electric lighting properties it does not seem possible that the movement in favor of municipal operation of electric lighting plants, based upon the assumption that a municipality can produce electricity cheaper than, or even as cheap, as a private corporation is well founded. We all realize, from the close attention we have to give to our own affairs, that self-interest and the necessity of getting a return on our investment are the first essentials to the economical administration of large enterprises. While I do not pretend to claim that electric lighting companies are beyond reproach, I wish to point out that many of the evils complained of as pertaining to corporate management are the direct results of the enforcement of unwise conditions through legislative action. Ill-advised efforts are often made by legislative bodies to secure advantages in the direction of control which cannot be obtained without giving an equivalent in protection to the industry. This causes the investor to feel that his property is being attacked and compels him to resist such legislation. The result is a feverish agitation, crimination and recrimination, between the would-be improvers of municipal government and the owners of corporate properties without reaching a conclusion satisfactory to either. The fallacy of the so-called reformer's theory results from looking only at what he calls the injurious effects of corporate management without taking into account its indisputable benefits. He does not seek for the cause of the trouble. If reformers will take accurate account of all the points in the problem they will discover that the evils complained of result from errors in legislation designed to determine the relations between municipal bodies and electric lighting companies. It seems to me that the claim that municipal operation is the universal cure for all diseases for which electric lighting companies are supposed to be responsible, merely proposes the substitution of political in the place of industrial management. This raises the question: Is the administration of municipal affairs in the various cities throughout this country so economical as compared with the management of private industries and the class of service rendered so efficient as to justify the increasing of the burdens already imposed upon municipal government? It appears to me that a correct division of power and responsibility requires political government to control private industrial management. Where political government and industrial management are merged into one interest, the power of control is seriously impaired, since a political administration cannot be reformed without overturning the party in power.

I cannot bring myself to the belief that the citizens of this great country are in fact opposed to large aggregations of capital in corporate form, as such aggregations are absolutely necessary to the operation of all great undertakings by private enterprise. It is as impossible to operate such vast affairs with individual capital, as a personally owned business, as it is for us to live without municipal, state and national governments. The misunderstandings which from time to time occur between communities and the managers of electric lighting companies will, to my mind, disappear entirely if the relations between the two are correctly founded on the basis of public control, with corresponding protection to the corporations operating this industry. It would seem to me to be a very proper function for this association to address itself to educating the public to a definite legislative policy which will be fair to the municipalities, securing to the public the best service at the lowest possible price, and protect corporations by giving them franchises, which, while conserving municipal control, will insure to the investor the permanency of the undertaking.

COMPETITION IS NOT THE TRUE REGULATIVE FORCE.

It is supposed by many who discuss municipal affairs that the granting of competitive franchises for public service work is the true means of obtaining for users the lowest possible price for the service rendered, whereas, as a matter of fact, the exact opposite is the ultimate result. This is proved by results in all large cities where the most severe competition has taken place. Acute competition necessarily frightens the investor, and compels corporations to pay a very high price for capital. The competing companies invariably come together, and the interest cost on their product (which is by far the most important part of their cost) is rendered abnormally high, partly owing to duplication of investment and partly to the high price paid for money borrowed during the period of competition. The selling price of a service should be based on its cost, and in any business such as public work, where the investment is large and the annual turn-over is comparatively small, if the item of interest be unnecessarily augmented, it must be reflected in the price paid by public and private users.

While it is not supposed to be popular to speak of exclusive franchises, it should be recognized that the best service at the lowest possible price can only be obtained, certainly in connection with the industry with which we are identified, by ex-

clusive control of a given territory being placed in the hands of one undertaking. In most European countries public service operations enjoy exclusive franchises, under proper control, and are able to obtain capital for their undertakings at the lowest commercial rates, thus materially affecting the cost of their product, of which interest, as I have already stated, is necessarily so great a part. In order to protect the public, exclusive franchises should be coupled with the condition of public control requiring all charges for services fixed by public bodies, to be based on cost, plus a reasonable profit. It will be found that this cost will be reduced in direct proportion to the protection afforded the industry. The more certain this protection is made the lower the rate of interest and the lower the total cost of operation will be, and consequently, the lower the price of the service to public and private users. If the conditions of our particular branch of public service are studied in places where there is a definite control, whether by commission or otherwise, it will be found that the industry is in an extremely healthy condition, and that users and taxpayers are correspondingly well served.

COMPENSATION FOR FRANCHISES.

When prices for services are based on cost it matters not whether in the establishment of a system of legislative control provision is made for paying a portion of the receipts direct to the municipality. If the public demands a percentage, surely we can afford to pay it, as it would simply be added as an item of expense on which our selling price would be figured. If the public does not demand a percentage, this selling price would be proportionately less. It is simply a question as to whether our municipal bodies prefer to raise a portion of their income by taxing their citizens through the agency of public service corporations, or whether they prefer to raise that portion of their income by collecting it direct from citizens themselves. Revenue raised by a percentage on gross receipts of the electric lighting business would, at the present time, however, seem to be somewhat unfairly obtained in cases where the selling price is subject to legislative control and based on cost of service, as the result would be that a small minority of citizens using electricity would be forced to contribute largely to the public revenue, whereas the benefits enjoyed therefrom would be to the advantage of the whole community.

TAKING PRIVATE PROPERTY FOR PUBLIC USE.

Another point that should be included in a proper scheme of public control is a condition under which the municipality would have the right to purchase the undertaking. Such a right should include a direct obligation on the part of the municipality to purchase the property at a fair price whenever it is thought desirable that the industry should be operated by the municipality. The possibility of the exercise of the right of purchase by the municipality would of itself make it to the interest of the owners of the property to do their full duty in their relations to the public. On the other hand, if a community licenses a corporation to perform a certain public service, and if that corporation invests its money and develops its business, surely it is unfair for that community to go into the same line of public service work itself without first purchasing the existing plant. If this is not done the value of private property will be destroyed without just compensation being made therefor in an attempt to secure a public benefit. I do not believe that the people as a whole are so unfair as to demand that such a course shall be taken.

My recommendations on the subject, which I have just presented, are by no means original. Most public service corporations in Great Britain are run on practically the bases indicated, and in more than one State in the Union corporate legislation has taken the same direction.

I would summarize the position which I think we should take on this subject in just two sentences.

First—Franchises granted to public service corporations should secure them the same degree of protection in their rights to their property as is enjoyed by other investments.

Second—Public control of charge for service based on cost plus a reasonable profit, and eliminating the factor of competition, is the proper safeguard for the interests of users, taxpayers and investors.

ATTICA, IND. The Attica Electric Light Company are increasing their plant by the addition of a 125 h. p. Ball engine, built by the Ball Engine Company, Erie, Pa.

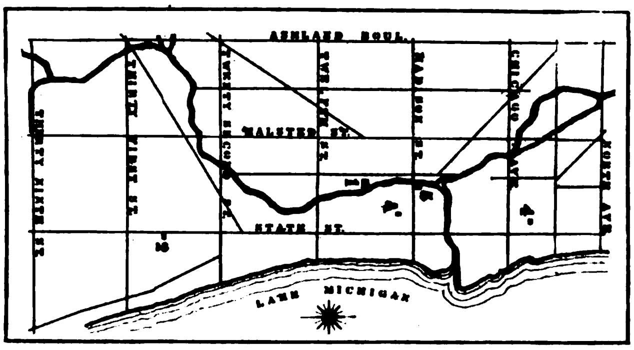
General Distribution from Central Stations by Direct Currents.[1]

BY LOUIS A. FERGUSON.

THE subject of Central Station distribution by direct currents is one which is so familiar to many of you that I hesitated when asked to write this paper, feeling that it would be difficult to present to you any new thoughts or experiences, so I trust you will pardon me if in the attempt to precipitate discussion and bring to the attention of the meeting the ideas and experiences of others, which is, after all, the object of my paper, I may trespass upon ground previously explored.

Nor do I wish to be construed as advocating blindly the general use of direct currents under all conditions, for both transmission and distribution of electricity for lighting and power purposes in cities and towns, for records will, I think, clearly show that the writer was the first of the so-called Edison Central Station men (who have represented the direct current idea in Central Station lighting) to advocate the introduction of the alternating current as a means of effecting important economies in the operating of the direct current distribution systems, and also vastly extending their field of operation, which without the combination of alternating currents might have remained, despite their distinct advantages, unfortunately limited to a comparatively small and closely populated area.

The general design of the modern direct current Central Station and its equipment has been fairly well established within the past five years, and while it was originally the custom to erect the generating stations as nearly as possible in the electrical centre of the city or town, it is now generally conceded that direct current may be more economically distributed from a condensing station situated even a mile distant from the electrical center than from a non-condensing station located at the electrical centre of the city, and it has been further demonstrated that the former practice of building many central generating stations in various centres of distribution in cities is to be supplanted by the use of one or two large condensing stations generating direct current for distribution throughout the business district if the station be within one mile of the electrical centre of the district, and alternating current for transmission to sub-stations located at the electrical centres of districts more remote from the main generating station. In some cities water for condensing purposes may not be easily obtainable within a distance of one mile, and the location is then merely a question of total cost of land, building and transmission lines to the various distributing stations, proper consideration being given, of course, to the limitations of line voltage and insulation.



CHICAGO EDISON AREA OF DISTRIBUTION.

In order to show the workings of the first mentioned type of modern direct current Central Station systems, I will explain in a general way the method of distribution employed in the system of the Chicago Edison Company, which I think fairly represents the latest development in direct current distribution, and leave the explanations of the methods of direct current distribution in other cities to the representatives of the companies operating them.

The system of distribution is a solid net work of underground conductors on the three wire system, extending from North avenue to 39th street, a distance of six miles north and south, and from Lake Michigan to Blue Island avenue, a distance of one and one-half miles east and west. The entire net work is

[1]Read before the Nat. Elec. Light Ass'n, Chicago, June, 1898.

continuous from end to end, and is supplied at present from four central stations, all connected in parallel through the net work and each feeding into it. The two large stations located at Harrison street and Washington street on the Chicago River, and known as Stations No. 1 and No. 5 respectively, are condensing plants, while the stations on the north side and south side, located at North Clark and Oak streets and Wabash avenue and 27th street, known as Stations No. 4 and No. 2 respectively, are non-condensing.

The total current furnished to the net work at the time of maximum load of the system in the winter of 1897 was 50,730 amperes, and is divided as follows:

	Amperes.	Per cent. of total.
Station No. 1	35,600	70.2
Station No. 5	7,600	15.0
Station No. 2	3,400	6.7
Station No. 4	4,130	8.1
	50,730	100.00

The total low tension direct current kilowatt hours output for the stations for the fiscal year of 1897 was 15,255,466, divided as follows:

	Low tension Kilowatt hours.	Per cent. of total.	Maximum station voltage.	Yearly average station voltage.
Station No. 1	11,335,618	74.3	149.	126.2
Station No. 5	2,314,473	15.2	142.5	129.6
Station No. 2	808,158	5.3	125.0	119.0
Station No. 4	797,217	5.2	123.5	120.1
	15,255,466	100.0		

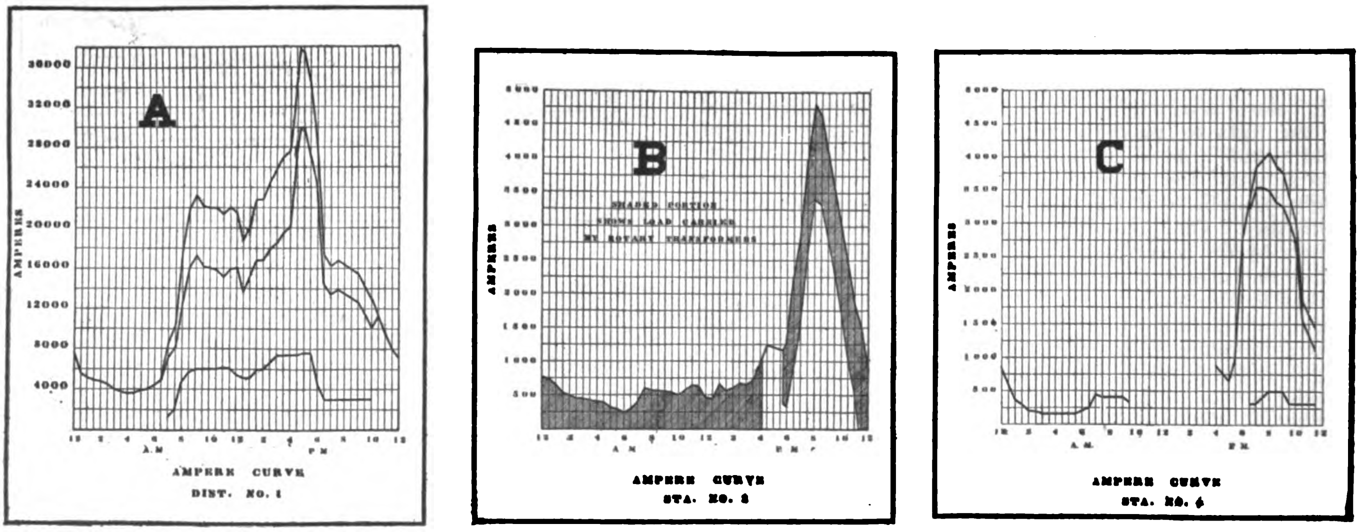
The pressure at the feeder ends throughout the system is maintained at 115 volts on each side of the three wire system. Although the maximum station pressure is 149 volts, the average pressure of all stations for the year is 126.2 volts, giving an average loss of pressure of 11.2 volts or 8.8 per cent., which means an average yearly efficiency of distribution of 91.2 per cent. from the station switchboards to the customer's meter.

the output of districts No. 2 and No. 4, from dusk until midnight daily, and ultimately they will furnish all of the output of the territories mentioned, and all of the energy required for alternating transmission lines into the outlying districts of the city and its suburbs.

The load curves "A" here shown, indicate the amperes furnished in district No. 1, by Stations No. 1 and No. 5, the small lower curve representing that delivered by Station No. 5, and the lower large curve showing that delivered by Station No. 1, and the upper curve representing the total amperes delivered to district No. 1.

The distribution of current from these two stations to the underground net work is as follows:

From Station No. 1 to the Adams street sub-station is laid an immense trunk line known as the Adams street trunk line, having a total cross-sectional area of 66,000,000 circular mils, 28,500,000 circular mils being ordinarily connected on the positive and negative sides and 9,000,000 circular mils in the neutral. The length of this trunk line is 3,340 feet, and is made up of fifteen special Edison tubes, each 3,000,000 circular mils area, laid directly in the ground, and fourteen 1,500,000 circular mils stranded rubber insulated, lead covered, and juted cables drawn into cement lined iron ducts. The trunk line on leaving Station No. 1 goes down a shaft sixty feet, thence through a brick tunnel built especially for it in the river bed to the east side, where it rises again in another shaft sixty feet into the tunnel house, where a small switchboard is located. The portion of the trunk line in the shafts and tunnel, which is 430 feet in length, is made up entirely of cables, of these forty-five are 1,000,000 circular mils Siemens jute insulated and fourteen are 1,500,000 circular mils General Electric rubber insulated, leaded, asphalted and iron armored submarine cables, each supported on iron racks. Where the cables hang vertically in the shaft, the cable is supported by the iron armored sheathing clasped between iron plates on a heavy cast-iron ring. The copper conductors thus hang in a sort of basket, the strain being distributed throughout the length of the cable. At the tunnel house the forty-five Siemens 1,000,000 circular mils cables connect with



LOAD CURVES, CHICAGO EDISON CO.

The centre of distribution in the business district of the city is at Adams street, between Clark and LaSalle streets. Station No. 1, which, as has been shown, furnishes 74.3 per cent. of the total low tension output, is located on the Chicago River at Harrison street, 3340 feet distant from the centre of distribution at Adams street. Station No. 5, which furnishes 15 per cent. of the total low tension output, is located on the Chicago River at Washington street, and is 4,500 feet from Station No. 1, and 3,000 feet from the Adams street sub-station.

These two stations furnish all the low tension output for the district bounded by the river on the north, Harmon Court (approximately) on the south, Lake Michigan on the east and the river on the west. They also furnish all the energy for the entire low tension system of the city during the hours from midnight until dusk the following afternoon, and a portion of

fifteen 3,000,000 circular mils single pole Edison feeder tubes, and together with the fourteen 1,500,000 circular mils cables are mounted on racks in a large subway, into which the duct line enters about 200 feet east of the tunnel house. At intervals of about 500 feet manholes are built in the Edison tube portion as well as in the conduit portion of the trunk line, thus affording a quick means of locating low insulation points as they develop. Each of the tubes and cables is provided with an amperemeter at Station No. 1, and with switches at both ends so that they may be completely disconnected from the system in case of trouble. Two of the 3,000,000 circular mils tubes are provided with throwover switches and arranged so that they may be quickly connected either to the positive or neutral or negative or neutral at will. All of the cables are provided with throwover switches on both ends, so that they may be operated

either as positive or negative at will, thus providing for any possible contingency that may arise. At the Adams street sub-station the trunk line feeds into the main bus-bar in the Distribution Room, and from the switchboard forty-two feeders radiate to various points in the business district, ranging in size from 250,000 circular mils to 1,000,000 circular mils, and in length from 290 feet to 2,831 feet, the average size being 485,000 circular mils, and the average length of feeder 1,373 feet.

The maximum current in amperes carried over the trunk line and distributed from the Adams street sub-station last December was 34,400 amperes, the maximum loss of pressure on the trunk line being 12.4 per cent., and to the customers' meter 22.8 per cent., the distance to farthest feeder end being 6,171 feet. In addition to the current furnished to the trunk line, Station No. 1 also delivers from its main bus-bar current to the two 1,000,000 circular mil feeders which feed into two points in the southern portion of the business district. One of these feeders terminating at Wabash avenue and Harrison street is 3,800 feet in length and carries with maximum station pressure 780 amperes on each side, the other terminating at Eldredge Court and State street is 4,800 feet in length and carries with maximum station pressure 620 amperes on each side. The supplying of district No. 1 by Station No. 5 is done in much the same manner as that just described by the two feeders from Station No. 1 into the southern portion of the district. From Station No. 5 eight feeders, varying in size from 400,000 circular mils to 1,000,000 circular mils, and in length from 2,175 feet to 4,445 feet, terminating at different points in the northern section of district No. 1, deliver a total of 7,600 amperes at maximum station pressure of 140 volts, the amount of current furnished during the run being only enough to maintain standard system pressure at the feeder ends, the curve of station voltage following very closely that of Station No. 1.

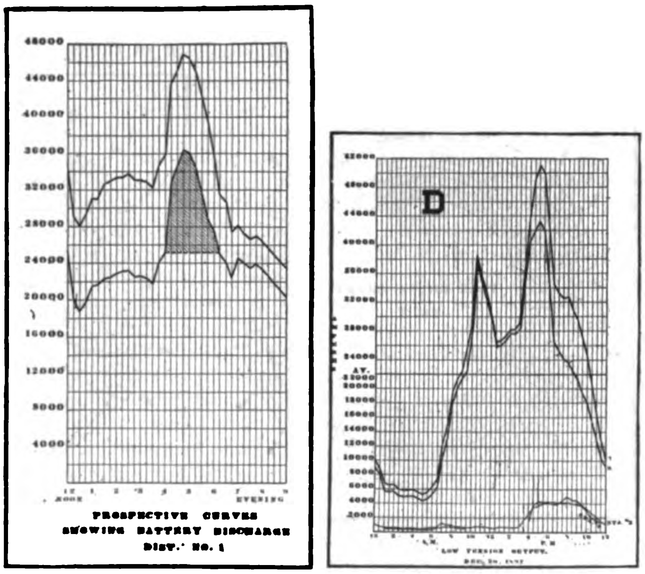
Station No. 2, which is now really a rotary transformer substation, is 17,500 feet from Station No. 1, and 14,300 feet from Adams street sub-station. The load diagram "C" shows the amperes delivered to District No. 2, the cross hatched portion representing the current furnished through the rotary transformers and the unshaded portion representing the current furnished by the dynamos in Station No. 2, the dynamos and rotary transformers operating in parallel on the three wire system. The upper curve shows the total amperes delivered to District No. 2.

Station No. 4, which now operates only from dusk till midnight, and will later become a sub-station, is 11,500 feet from Station No. 1, 9,000 feet from Station No. 5, and 8,000 feet from Adams street sub-station. The load diagram "C" show the amperes delivered to District No. 4. The portion of the curve from midnight until 3:30 p. m. on the winter day and until 6:30 p. m. on the summer day is furnished from District No. 1 through the inter-connected underground net work, the District No. 4 being, during these hours, merely an extension of District No. 1, and having no distinct supply delivered through its own switchboard. From dusk till midnight the generating plant in Station No. 4 is operated, and the current is delivered as shown by the next to the highest curve on the diagram, the low curve marked No. 5 representing the amperes furnished by Station No. 5 to District No. 4 over a direct current tie line between the switchboards of the two stations. The tie line is made up from one feeder running out of Station No. 5, originally feeding into District No. 1 and now connecting by means of River cables with a feeder out of Station No. 4, which formerly fed into the district at a southern point. This tie line is switchboard, thus relieving the network between Districts No. 4 by connecting onto the main bus in Station No. 5 and allowing it to take a small current and deliver it to Station No. 4 switchboard, thus relieving the net work between Districts No. 1 and No. 4 of some of the work. Between the hours of midnight and 8 o'clock in the morning there is only one low tension direct current generating station operating (Station No. 1) supplying direct current to District No. 1, and through the net work to District No. 4.

District No. 2 is supplied from Station No. 1 by means of a converse rotary transformer connected to the 250 volts direct current bus-bars, converting to three phase alternating current at about 160 volts. By means of step-up transformers this is raised to 4,500 volts, and at this pressure the energy is transmitted by three phase underground transmission line to Station No. 2, where it is reduced by step-down transformers to about eighty volts and converted by means of rotary current transformers to direct current at about 115 volts.

For the permanent conversion of Station No. 2 into a substation a pair of special 200 kilowatt generators are being installed, directly coupled to the existing 600 h. p. triple expansion engines in Station No. 1. Each generator is provided with a commutator and a set of three collector rings, and is designed to deliver from the same armature direct currents and three phase alternating currents, the direct current sides of each pair of machines being connected in series to form a three wire unit, and the alternating current sides, after passing through transformers stepping up to 4,500 volts, being connected in multiple. The alternating current from these machines will be taken to supply the transmission line to Station No. 2, and the balance of the capacity of the machines will be delivered directly into the main direct current bus-bar of Station No. 1, thus keeping the unit operating at full load and maximum efficiency during its run. The peak of the load in District No. 2 arrives later than the peak of District No. 1, so that the same investment in steam and electrical machinery may be employed to take care of a portion of the peak in both districts, these special generators constituting a reserve or surplus for the direct current equipment of Station No. 1.

Lest I might wander from the subject of the paper, I shall not now dwell further upon the question of transmission of energy by alternating currents, although it plays an exceedingly important part in the distribution of electricity by the Chicago Edison Company.



LOAD CURVES, CHICAGO EDISON CO.

Uniformity of pressure throughout an incandescent electric lighting system is absolutely essential to commercial success. To accomplish this different methods have been proposed at different times. It often happens that the original plan of distribution, laid out by the constructing engineer, does not meet the requirements, after several years' growth of the business, for in all cities lighting business may localize at certain special points, and so demand a remodelling of the existing system of conductors, or require some means of correcting for the inequalities of pressure that are due to the unevenly distributed load.

In the Edison systems built prior to 1890, it was customary to introduce in series with each feeder a resistance box with capacity to carry the entire current of the feeder and of resistance much greater than that of the feeder itself. The resistance box is commonly known as a feeder equalizer. From the end of each feeder where it connected with the mains, a set of pressure wires was run back to the station and there connected to pressure indicators. The method of regulating was to designate the feeder supplying the most important district in the system the standard feeder, and to keep its pressure constant, say 110 volts. Each pressure indicator of the other feeders was differentially wound, so as to receive the pressure of the standard feeder as well as the pressure of its own feeder. When

there was any difference of pressure between the standard feeder and a given feeder, the latter's indicator needle would deflect to one side or the other according as the pressure on that feeder was higher or lower than the standard, and if equal of the standard, the indicating needle would stand in the centre. If, then, any indicator showed that its feeder was low in pressure, some resistance would be cut out of its feeder equalizer, and, the resistance diminishing, the volts loss on the feeder would then become less, and thus the feeder could be brought to the same pressure as the standard. If the pressure of the feeder were high, the operation would be the reverse.

With this method of regulation, the entire output of the station must be at such pressure at the station switchboard as will permit the delivery of the correct pressure at the end of that feeder, the product of whose load and resistance is greatest in the system. There are some large stations in America operating to-day on this plan of regulation, notwithstanding that it is an expensive and troublesome one. Another method of regulating, which may be employed where the load is fairly well distributed, is by cutting out the feeders which are high and forcing the current to travel through the remaining feeders and the mains, thus increasing the fall of pressure to the end of the feeders which were formerly high.

The only economical and safe way to regulate in a city where the distances are not abnormally great, and where the load is fairly well distributed, is to so design the conducting system that it will be self-regulating, that is, so that it will require no change of the resistance of feeders or anything of the kind.

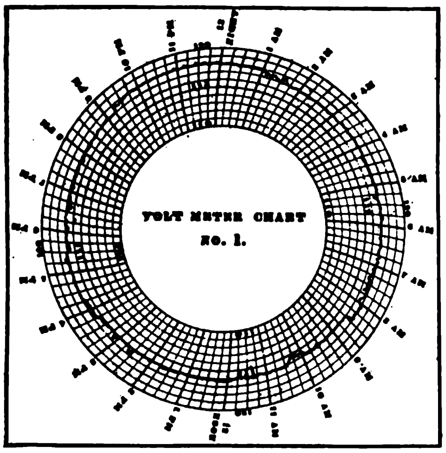


Chart No. 1, represents the pressure for 24 hours on the direct current distribution system in the business district of Chicago, the average deviation from the mean pressure is less than one volt.

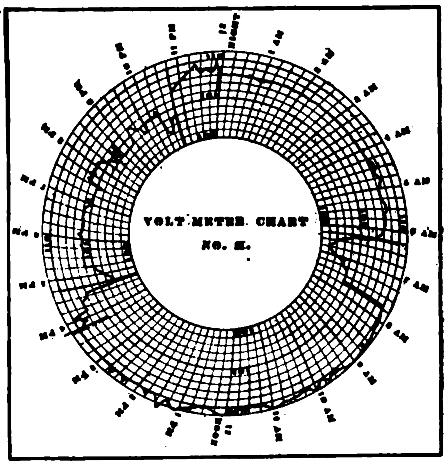


Chart "H," represents the pressure on one of the circuits of a single phase, house to house transformer, alternating system in Chicago.

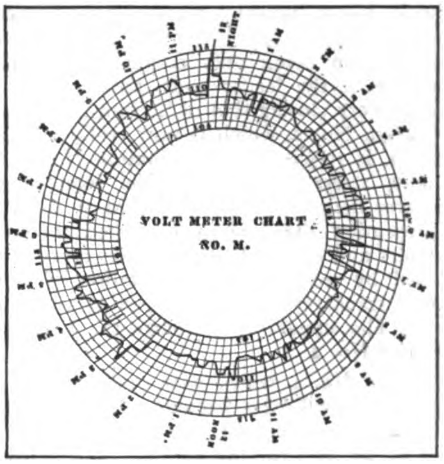


Chart "M," represents the pressure regulation of an alternating current system on a long avenue, where are used primary feeders with four 15 k. w. transformers, the secondaries in multiple on the three-wire system.

A good conducting system should have an ample number of feeders reasonably close together, and the connecting mains should be of generous cross sectional area.

A valuable adjunct to a station, where there are one or two straggling feeders of great length so located that they cannot be interconnected with the general system so that they may be benefited by such connection, is what is known among the Edison companies as the "Booster." The "Booster" is a direct current dynamo wound for a large current and low voltage, and is used for raising the pressure of the station and of the feeders which are ordinarily low. The "Booster" dynamo should be series wound and so designed that its voltage will be proportional to the current passing through it, the speed remaining constant. It is connected in series with the feeder, whose pressure is to be raised, and is belted to or directly connected with a motor which drives it at the speed for which it is designed. Its action is as follows: The current passing out on the feeder also passes through the field and armature of the "Booster" dynamo, and an electromotive force is thus added to that already existing on the feeder due to the dynamos of the general system. As the load on the feeder increases, the electromotive force of the "Booster" dynamo increases proportionately, and adds to that of the feeder, thus overcoming the loss of pressure due to the increased current in the feeder, which enables the feeder to deliver the proper pressure at its mains. The "Booster" may also be employed to raise the pressure of a number of feeders which are connected to an auxiliary bus-bar. In this case, the "Booster" would be connected between the main bus and auxiliary bus, and would carry all the current of the auxiliary bus, raising the pressure of it as its load increases, and decreasing as the load decreases, as described in the case of the single feeder.

In some central stations two or more potentials or pressures are used, certain dynamos working on a bus-bar at one pressure and the other dynamos working on another bus-bar at different pressures.

This method is only economical when the dynamos can be worked very near the maximum load, which is not often the case. In some cities the dynamos in central stations or machinery or storage batteries in sub-stations feed into one general system at different points, each station or sub-station operating at such pressure as will deliver the same voltage at the feeder end of the mains. This is, without doubt, the method to be recommended as giving the best efficiency and assuring reliability of service throughout the system.

With the method proposed in case of accident to any one station, either by fire or lack of water supply, the whole system will not be shut down, but each station will take its share of load which comes from the shutting down of the disabled station.

Municipal legislation in all large cities requires, and very justly so, that the wires for the distribution of electricity for lighting and power purposes should be laid underground. The Edison companies throughout the country use a standard system of underground, the mains and feeders consisting of japanned iron pipe in which are three solid copper wires or rods insulated from each other and from the iron pipe by an asphaltum compound. These pipes or "tubes," as they are commonly called, are twenty feet in length, the copper conductors projecting three inches on each end, making the total length of each pipe twenty feet six inches.

The copper conductors are connected together by means of a flexible coupling, composed of a stranded copper cable about eight inches in length, and having copper terminals on either end, and which are provided with a circular opening of such diameter as will permit the reception of the copper conductor of the tube. The copper terminal is heated by the flame from a blow lamp, and the conductor is soldered into the terminal.

After the three couplings are connected an iron ball clamp is bolted on to the tube near the end, and a cast-iron oval-shaped coupling box is laid over the copper joint and fastened together by bolts and nuts. The coupling box is then filled with hot insulating compound, and after this has settled by cooling, the box is again filled and the opening covered by plugs.

At each street intersection these tubes enter a junction box. The junction box is a cylindrical cast-iron box in the centre of which is a cast-iron upright standard carrying three rings of flat copper bar. To one of these rings all of the positive conductors are connected, to another ring all the negative conductors, and to the remaining ring all of the neutral conductors are connected in a similar manner.

Many of the junction boxes are fed by a feeder direct from the central station, the feeder, when Edison tubes are used, being laid in the same manner as the mains before described. The feeders in a three-wire system consist of three conductors, as in the case of mains, with the exception that one conductor which

is used as a neutral has usually one-third the area in cross section of either of the two other conductors. Feeder tubes are made in various sizes, from 250,000 c. m. up to 3,000,000 c. m. Each feeder tube also contains three small insulated copper wires, which are connected in each coupling box to the corresponding wires in the next tube, thus making a continuous circuit from the feeder end in the junction box at street intersection back to the station. At the generating station these wires connect with a pair of volt meters, and at the end of the feeder they are connected through fusible strips to the copper rings in the junction box, thus giving in the station the pressure or difference of potential at the feeder end. By means of the junction boxes the system becomes one grand net work of conductors connected in multiple and fed at many points by feeders from the central station, similar to that of a well designed gas or water system in a large city. By means of this net work of mains the electrical pressure is equalized throughout the system, and the current is distributed properly among the feeders. Every mechanical and electrical detail of the system is very carefully worked out and absolutely interchangeable, and it is without question, when cables are used for the feeders, the most complete, most easily operated, and most permanent underground system yet devised for the distribution of electricity for large cities using a direct current system of 500 volts and under. With this system the customers are almost absolutely certain to have continuous service, as they are fed from two points under ordinary conditions, and should the main in their block burn out, it is nearly always possible for the company to feed the customers from one or another junction box. The method of coupling affords a perfect house to house system of distribution, and renders the placing of services a very easy and simple matter. The system is very easily laid down, and its maintenance compares favorably with other methods of distribution.

The maintenance of good presure regulation at the customer's meter is very much more easily effected with an interconnected direct current distribution such as has been described, than with the ordinary alternating current central station system, such as has been exploited in this country.

Owing to the parallel operating of direct current dynamos and distribution systems the fluctuations in the pressure, due to change over from one machine to another, so prevalent in the ordinary American alternating current central station, and so annoying to customers, are eliminated, and a carefully operated direct current central station should show a pressure chart with an average deviation from the mean of less than one volt.

It is possible, of course, and often the careless practice in direct current stations to have bad fluctuations of pressure at the times of change over, and also irregularities at other periods, but there is absolutely no excuse for their existence in a well operated and well planned direct current system.

The parallel operating of the generators greatly simplifies the maintaining of uniform pressure regulation at the lamps, since when several units are connected to the common bus-bar the regulation for the entire system may be effected by careful attention to one unit, whereas in alternating current stations where the generators do not operate in parallel it is necessary, in order to even approach the uniformity of pressure regulation which exists in direct current systems operating in parallel, to regulate the pressure accurately on each unit, which is seldom done in practice. Besides the better regulation possible with parallel operating of the dynamos, a further distinct advantage is derived from the economy effected by proper division of load among the units in the stations, this being particularly marked when the distribution systems are also interconnected. Each unit, irrespective of size, may be usefully and efficiently employed at the period of maximum load, and the amount of idle or uneconomically employed investment is reduced to a minimum.

To illustrate the comparative accuracy of regulation obtainable in an interconnected direct current system, and in the ordinary type of independent circuit alternating current system, let us refer to the pressure charts shown in the enclosed sheets.

If the engineer designing a system employing alternating current in the distribution, expects to obtain first-class pressure regulation, he must follow those lines laid down by the engineers who have developed the modern direct current distribution system. The distribution system of mains should be interconnected, forming one grand net work of conductors with large transformers, located at points where feeders would terminate if it were a low tension direct current system, and to these transformers should be brought the primary feeders from the central station, provided with boosting transformers or induction regulators. Pressure wires from the secondaries of the transformers should be brought back to the station so that the pressure on the ends of the mains may be known and properly controlled. Such a system will be described to you in detail by Mr. Wagner, and I am sure he will agree with me when I say that the single-phase, house to house transformer, separate circuit alternating current system, such as has been generally exploited in this country has nothing to recommend it to the central station manager, either from a purely engineering or financial standpoint, although it has fulfilled its mission as a pioneer in the introduction of electric lighting in scattered districts.

One of the advantages to be derived from the use of direct current distribution as distinct from alternating current distribution, is the employment of storage batteries. They may be adopted for use in various ways, in sub-stations in outlying districts where the load factor of the district is very small, in the central stations themselves to deliver the entire output during period of minimum load, at the centres of distribution for discharging during the peak, as auxiliaries in rotary transformer sub-stations for discharge use at the time of the maximum load in the main central station. In addition to any one of the various ways which the battery may be employed, it always acts as a reserve, guaranteeing the consumer good service, in much the same manner as a bank surplus is a guarantee to the depositors in cases of financial emergency.

Storage batteries when installed in central stations or centers of distribution are usually connected to the main bus and allowed to float on the system taking a charging current from the bus or discharging into the bus according to the load on the system, the generating units being worked at such load as will insure the best efficiency of the entire system.

Batteries are economically valuable in connection with the distribution of direct current in systems whose load curve has an average peak width of not more than two hours, since the investment required for storage batteries to carry the peak having an average width of less than two hours is less than the investment required in steam and electrical machinery to do the same work. The storage battery also has the same value that exists in the case of moving machinery as a reserve in meeting sudden increases of load, provided such increase of load does not continue for a sufficient period to wholly discharge the battery and insufficient time remain for recharging before the ordinary load peak of the system appears at the regularly appointed time. Such a condition is rarely and I might say almost never met with, although in rare instances we may approach this condition.

The steam and electrical machinery is rated by the horse power or kilowatt, and the duration of the load peak does not influence the value of the investment since the machinery may be operated for the full twenty-four hours at its maximum capacity. The storage battery, however, is rated by the horse power hour or kilowatt hour, and the investment is nearly directly proportional to the number of hours during which it discharges the maximum capacity, so that if we required the battery to be prepared to carry the full peak prolonged for seven or eight hours every day the investment in battery would be enormous as compared with steam and electrical machinery to furnish the same kilowatt hours output. Illustrative of such contingency, let me refer you to the load diagram marked "D," representing the load in the business district of Chicago, December 20, 1897. This is a very extraordinary curve, illustrating the limitation of the storage battery and the posibility of its being rendered ineffective had the early morning peak extended to the arrival of the regular afternoon peak, without affording sufficient time for recharging the battery.

The storage battery has a very distinct value, which is seldom recognized and employed to its full advantage, when located at the central distributing point of a system with feeders radiating to various points in the net work. The battery may be provided with two or more end cell switches, so arranged that they may be connected in multiple and feed into the main distributing feeder bus, or they may connect also to one or more auxiliary bus-bars with a different number of cells in series, feeding into each bus, thus providing two or more potentials at the centre of distribution. It will be found that when only one pressure is

maintained at the centre of distribution during the time of maximum load of a large district that the pressure at the ends of the short feeders will be somewhat higher than the standard and they will be overloaded, and at the end of long feeders the pressure will be lower and the feeders underloaded, although the pressure variation at other times may be negligible. Under such conditions the storage battery becomes exceedingly valuable, for by arranging it to operate at two or more potentials, the long feeders may be connected during the time of maximum load to the auxiliary bus or busses and additional current forced over them, utilizing their full capacity and maintaining a uniform feeder end pressure by means of an investment in end cells very slight as compared with the investment in additional feeders and mains required to accomplish the same result.

The direct current distribution system is very much better adapted to electric elevator work than the alternating current distribution, and as far as I am able to learn there has not yet been developed a commercially successful direct coupled electric elevator capable of running at varying speeds and operated by alternating currents.

The direct connected electric elevator is a piece of apparatus which is of the greatest value to the central station companies, since it is practically the key to the isolated plant situation, and with its aid we are enabled in a large percentage of instances to show to the owners of large mercantile establishments and buildings a decided saving in the purchasing from the central station company of electricity for lighting, elevator and general power service as compared with the cost of operating an isolated plant, using hydraulic elevators. The immense advantage to the central station companies in being able to supply commercially successful electric elevator service economically. may be realized when we consider that there is connected to the systems of the Edison companies in New York, Boston, Brooklyn and Chicago 15,000 horse power capacity in direct connected elevators, representing a gross income of approximately $375,000 annually. At the present time alternating current distributing systems confine us to the use of continuous running motors belted or geared to the elevator pump or winding equipment; but such an arrangement is not fitted for first-class passenger service and is very uneconomical, and similar equipments using direct current motors were in use ten years ago and have long since become obsolete and have been entirely superseded by the direct coupled electric elevator which operates for approximately one-half the cost.

The use of low tension constant potential arc lamps connected in multiple to the distribution system has made rapid strides during the past three years, and in New York, Brooklyn, Boston, Chicago and other cities is fast superseding the use of series arc lamps wherever the low tension mains operate, and the day is not far distant when series arc lamps will be employed only in the outlying districts where there is not sufficient business to warrant the extension of the low tension distribution system. The competition effected by the Welsbach gas burner has done much to develop the constant potential arc lamp, and it is safe to say that with incandescent lighting alone the central station companies are rendered helpless against the improved gas burners; but a successful competitor has been found in the use of the three and one-half ampere direct current enclosed arc lamp, and as proof of this we have only to compare the results of the central station companies in the large cities, where these small arc lamps have been employed, with the conditions existing in the small towns, where alternating current systems of distribution furnish incandescent lighting only. In the latter places the Welsbach light is found to be in general use and is affecting very seriously the earnings of these small central stations owing to the lack of an alternating current arc lamp, which would answer the purpose of the small ampere arc lamp used in connection with direct current systems. Although very much has been done within the last year in the development of the large alternating current arc lamp, it is still far from being in the state of perfection, and cannot be said to compare practically or economically with the constant potential direct current enclosed arc lamp.

The use of motor cycles and electric cabs employing storage batteries is becoming more popular every day and in London and Paris they are used very largely, in Paris an Automobile Club having been formed by people owning motor cycles. The central station companies using direct current will undoubtedly find a profitable outlet for their product as the motor cycle becomes more popular, and by locating charging stations for the motor cycles along the central station mains the use of the motor cycle will become more extended.

When we consider the many practical advantages inherent to the direct current system of distribution which add so greatly to the commercial success of a central station company, it would seem that the original investment required to establish the plant and system should not be the only question affecting the selection of the system to be adopted.

It is universally conceded by all competent and unprejudiced engineers that the alternating current system of distribution in a closely settled district, which shall approach in commercial value the direct current distribution system, shall be one which has for its basis an interconnected system of secondary mains, with transformers of large capacity, and high pressure feeders from the central station to these transformers and generators in the station operated in parallel, as previously described. Therefore the cost of the distribution net work in the case of the alternating current system will not be less than that of the direct current net work, and the cost of transformers, high pressure feeders and alternating current dynamos should be compared with the cost of low tension feeders and low tension dynamos of the same capacity, these forming the only points of comparison. The investment in each case depends merely upon the advantageous location of the central station in each individual city.

I have shown in the early portion of the paper that in a large distribution system such as exists in Chicago, that seventy-five per cent. of the total energy supplied to the system is delivered to the business portion of the city covering an area of one square mile, the stations supplying this territory being three-fifths of a mile from its electrical centre. It is therefore self evident that since such a large portion of the energy supplied is so nearly adjacent to the desirable location of the central station that a direct current distribution system should form the basis of the general system of the company.

It seems to the writer that the useful field of operation for alternating current distribution system is not in large cities but rather in the scattered suburban residence districts and small towns where commercial lighting, elevator service and general power distribution forms an insignificant portion of the demand and where the first cost of the direct current installation would so far exceed that of the alternating current system of distribution with primary mains and large transformers for blocks of lighting as to make the interest charges so great that the property would be rendered unremunerative.

The successful central station company of the future will be, as outlined in my paper read before the Association of Edison Illuminating Companies at its last convention, the one combining intelligently the use of alternating and direct currents, employing direct current in the distribution systems in the thickly settled business and residence districts of a city and alternating current for the distribution systems in the scattered residence districts and surrounding suburbs. The energy will be generated at one or two large condensing stations located where water and fuel may be obtained at the minimum cost and the energy transmitted to the various substations located at the electrical centres of the distribution systems. The choice of low pressure direct current or high pressure alternating current for the transmission to the substations will depend upon their relative distance from the generating stations, rotary transformers or other forms of current rectifiers being employed in the substations which supply the direct current distribution networks when alternating currents are used for the transmission.

Electric Lighting Deal at Chester, Pa.

Ernest H. Davis, general manager of the Lycoming Electric Company, Williamsport, Pa., has purchased a large interest in the business of Beacon Light Company, Chester, Pa., and has been elected a director of the company. Mr. J. George Kaelber, for many years with the Western Electric Company, and well known in electrical circles, is vice-president of the company, and with Mr. Davis will give it his attention. The Beacon Light Company, of Chester, Pa., has purchased and leased the existing electrical interests and controls the city and commercial lighting of Chester and vicinity. Mr. George N. Tidd, former manager and electrical engineer of the Waverly Electric Light and Power Company, has been elected general manager and

electrician of the Beacon Company, and if his past record is any criterion, the success of the company in Chester is assured. Large extensions to the plant are contemplated and many improvements will be made during this season.

TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work—XIV.

BY A. E. DOBBS.

SELECTION OF INSTRUMENTS.

PROBABLY one of the most perplexing questions that the new Exchange management has to face is in regard to the selections of instruments. There are some manufacturers of instruments who are not telephone experts, and in consequence produce instruments that are not perfect by any manner of means; some are fairly good imitators, without possessing the knowledge necessary to successful imitation. They will overlook many important points, but at the same time produce an instrument that is good enough to sell to the inexperienced, and, when, after many months, the buyers' inexperience is succeeded by knowledge he will find that the manufacturers have also learned a thing or two, produced a new form of instrument, and it may be the greenhorn will be caught twice by the same maker. Besides, the newcomer is apt to be caught by low prices, and, I regret to say, competition makes some manufacturers use very inferior material, whereas, successful electrical instruments require correct proportions and good material, and nothing is too good for exchange service. A cheap telephone for exchange work is dear at any price.

Now, this is not to be taken that there are no good telephones made by independent concerns, for there are manufacturers who are doing honest, conscientious work, and trying by every means in their power to produce, and who do produce, as good instruments as are made anywhere, but at the same time purchasers should not always take the first instrument offered them, even under a guarantee, for there are selling agents who will

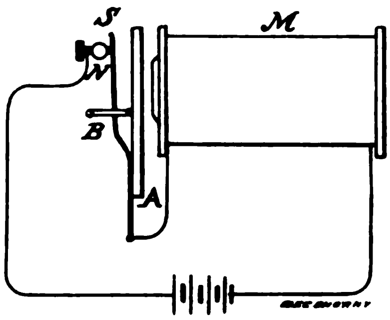


FIG. 43.

give any kind of a guarantee the purchaser may ask for in order to effect a sale; making the guarantee good is another matter.

The independent manufacturers have not yet brought out anything radically new. Their genius seems to have been confined to imitations of Edison and Hunnings which do not possess means of adjustment—which seem to be controlled by patents—and the only adjustment left is to put in more or less carbon until it becomes "about right." If this is carefully done and tests made at the factory, and the carbon is of good quality, there should no further trouble. But in the haste of getting out orders this is not always properly looked after, and many an instrument is condemned after a brief trial on this account. I have remedied the defects in many a transmitter by changing the quantity of carbon granules.

Another point to be noted in this connection is this: Have your instruments and coils as nearly alike as possible and when you have found an instrument that will do your work, take that as standard, and insist that all others shall follow it, unless changes are made to correspond all round. It does not improve the service to have some induction coils wound to 18 or 20 ohms, some to 125 and some to 250 ohms.

We also find buyers who, next to the price, always pay more attention to the outside appearance of an instrument than to its other qualities.

While admitting that the telephone as assembled up to date does not possess the æsthetic qualities one could desire (in fact it could be very materially improved in this respect, and the maker who really succeeds in doing so will score a hit), a utilitarian who has followed up exchange and instrument troubles for two or three years never notices the outside of an instrument at all unless it is a total wreck, his first impulse being to reach down into his pocket for a key and get the box open.

If, upon inspection, the inside shows permanent, substantial work, with contacts that look as though they could be relied upon, with the different circuits properly insulated from each other, with the ringing magnets properly shunted or cut out, and the general appearance indicating that it has been finished by workmen instead of apprentices, he regards these as a good sign.

Then, if, upon test, the receiver, the coils and the transmitter prove all right, he is disposed to accept it, regardless of its outside appearance. But if, on the other hand, he finds contact springs of cheap German silver or brass with weak and unreliable contact pressure, with no platinum anywhere visible, with solder and acid slobbered all around the inside of the box, with magnets looking rusty and cheap, with insulation looking as though it might break down at any time, with bell magnets in series with the talking circuit, and the wiring in such a shape as to be almost impossible of access, he knows that he will have trouble with that instrument from the very start, and no amount of gingerbread work on the outside can possibly redeem it, in his estimation.

I can recall the case of one company having a transmitter which, while new, will show up in fine shape, but in actual use develops troubles of the most aggravating nature, because their instrument wiring is out of reach and seems to have been designed and carried out by boys who were more used to making cheap call bells than anything else.

Suppose we study this question of contact springs. There seems to be an idea that because copper or brass is used in electric light switches and to a great extent in cheap call bells that it will also do for the telephone hook switch, forgetting that the contact on the smallest electric light switches covers several times the area and has many times the pressure of any telephone contacts.

In this connection it may not be amiss to tell a story of an experiment of the author's younger days.

The object of the experiment was to find out how long certain batteries would last on a continuously working circuit, which, however, was lost sight of in the experiments that followed. Not having a bell handy (for bells could not be bought for 20 cents apiece in those days) he made up a coil and magnet of his own, using wire enough to give a resistance of about two ohms. The apparatus, shown in Fig. 43, is crude, of course, but it was good enough for the purpose. The armature (A) was simply an old nail filed down and the spring contact on it (S) was of ordinary brass. The back contact (N) was a wire nail, to which one side of the battery was connected, the armature being pulled back by a rubber band (B), the whole being connected to four cells of battery. Owing to the large size of core used, there was considerable sparking at the contacts between S and N. With this amount of battery there was lively action at the start, but it soon stopped. As the battery did not present a run-down appearance, a search was begun for the cause, when a touch on the armature caused it to start again, only to stop again in a short time. This time an examination was made of the contacts, and it was found that they had blackened considerably. They were rubbed with sandpaper and the rubber band tightened to increase the back pressure, but with the same result as before.

This time there was a change of metals at the contacts and before the experiment was finished about every metal was tried to insure a reliable contact, with the same result, until a piece of carbon took the place of the nail (N) and a piece of silver to the strip (S), after which the service was fairly constant, but even the silver would blacken and cut out after long use, till finally a piece of platinum was secured, which stopped all further trouble, though two pieces of hard carbon would most likely have

worked well also. Now, of course, all contacts do not spark as badly as that one did, but the lesson was well worth learning, and has never been forgotten.

Moral.—See that all contacts have platinum in them, or else that a strong rubbing contact is had, for a strong rubbing contact will clean itself to a limited extent.

Look into one of the latest Bell instruments with, say, a Blake transmitter. Notice that the contacts on the diaphragm are platinum and carbon. The switch hook contacts are platinum altogether, yet even they get dirty once in a while; then notice how the door hinges are connected by a spring with soldered contacts and see how neatly the wiring is all done and how easy of access in case of trouble. Go into a telegraph office and examine the operator's key. There is a hard rubbing contact, yet in standard instruments you will see nothing but platinum points.

Of course, platinum is costly and there are switches made without it that do fairly well, and there are manufacturers who can make as good instruments as the Bell, or even better than the one with the Blake transmitter, and these points are merely mentioned to guide purchasers in their selection.

ELECTRIC TRANSPORTATION

Heavy Underground Electric Railroading Proposed in Paris.

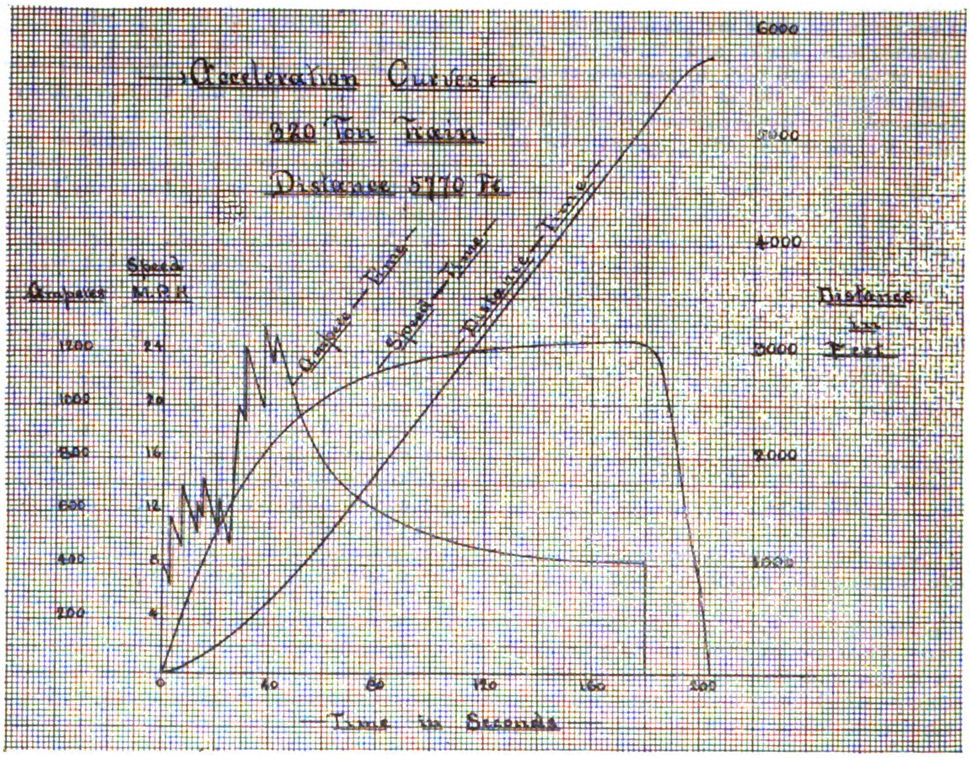
An enterprise involving the expenditure of not less than 40,000,000 francs, or $8,000,000, and the creation of a road, about two and one-half miles long, partly underground, to be operated exclusively by electricity, is about to be undertaken in the city of Paris by the Orleans railroad. The operation of this underground road, as at present contemplated, is to be carried on by means of electric locomotives driven by continuous current at a pressure of between 500 and 700 volts, using the third-rail system of contact. In asking for estimates, however, the company has requested bidders to submit plans also for the use of systems of generation and distribution other than that just mentioned.

The locomotives are to be eight in number, all alike, and able to haul a train of 250 French tons in seven minutes between the station of the Quai d' Orsay and the Pont d'Austerlitz without stopping at the intermediate station of the Pont St. Michel. This means a speed of 45 kilometers an hour. The locomotives should not only be able to haul a train of the weight mentioned on a grade of 11 mm. and on curves of 200 metres radius, but it should also be able to haul trains as heavy as 300 tons at a slower speed. The locomotives must be built to move in either direction, at the same speed, and be of a length to allow them to be turned on turntables 6.2 metres in diameter. They are to be equipped with motor-driven air pump and air brakes.

The electric generating station will be placed at the western end of the Valhubert station departing platform, taking the place of certain waiting rooms. The equipment is to be of sufficient capacity to allow of the simultaneous movement of four 200-ton trains, exclusive of the locomotive, upon the line—one starting from the Austerlitz station, one from the Quai d' Orsay station, the third climbing the grade of 11 m. m. and the fourth running between the Pont St. Michel and the present main station. Furthermore, the generating plant must include sufficient lighting capacity for the three stations already mentioned and the tunnel, as well as for the station and shops at Ivry. The current is to be taken by the locomotives from an insulated third rail at the side of the track in the stations and between the tracks over the rest of the line, due provision being made for all switches and cross-overs.

In order that a better knowledge of the operation of electricity in heavy traction service might be gained than was possible in Europe, the Orleans company recently sent over to America a corps of engineers to investigate the different electric railway installations of this type in this country. The party was headed by H. E. Solacroup, assistant chief engineer of material and traction, and M. Sabouret, the other members being Messrs. Hiberty, Fremenville and Walton. Their inquiries were conducted very quietly, but during their short stay they were able to visit almost every installation of special interest to them in the United States.

A special test was arranged for their benefit at Schenectady on the experimental two-mile track of the General Electric Company, the conditions of the track and load being, as far as possible, similar to those which will obtain on the line in Paris. A length of track was marked off 1.11 of a mile long by two white flags corresponding to the distance between the Quai d' Orsay



ACCELERATION CURVES, SPECIAL TRAIN RUN, SCHENECTADY, N. Y.

and the Pont St. Michel stations, the most difficult portion of the proposed Orleans extension. According to the time schedule arranged for the operation of the road, this distance should be covered in three minutes and fifty seconds. A train was made up of a motor car of the Nantasket Beach pattern, equipped with four General Electric 55-175 h. p. motors as locomotives, several New York Central coaches and seven flat cars loaded with pig iron, making a total train load of 320 tons, including the motor car, which weighed 45 tons. The run between the flags, including starting and stopping, was made easily in three minutes and twenty-five seconds, giving a margin of not less than twenty-five seconds to the good. The diagram on page 680 shows the acceleration curves of this run.

The question of rendering the third rail innocuous after the passage of the train having been brought up, the General Electric Company arranged an exhibition of its method of effecting this result. A section of the third rail was measured off and divided into sections in lengths varying from 30 feet to 500 feet. Connections were made between these and a system of automatic switches, and the conditions of the General Electric system of surface contact, almost exactly reproduced. By this system the arrangement of circuits is such that the sections into which the rail is divided may be of any length from that of a few feet to any number of miles, that is, any section of the conductor rail will be alive only when the train itself is running over that section. The instant the train passes to the succeeding section, that which it has just left becomes dead and absolutely innocuous. The use of this system also renders it possible to "section" the conducting rail at stations, leaving it continuously alive at all intermediate points. The switch cutting the dead section into circuit is closed as the contact shoe of the train comes into contact with the conductor, energizing it, and is automatically opened as the train passes to the next dead section.

The motor car was run over that part of the track beside which the third rail was sectioned, and as a visual means of indicating that the third rail was alive a number of incandescent lamps on the top of the boxes containing the switches were connected to the conductor. As the car reached the sections and rendered them alive, the lamps lighted up, being extinguished as the contact shoes passed over the dividing lines between the different sections.

These tests formed the subject of the concluding investigations of the French engineers in this country. A few days before their departure a dinner was tendered to them at Delmonico's, at which many prominent railroad engineers and electricians were present to meet them. They admitted having received many new ideas during their stay, and returned to France convinced of the use and possibilities of electricity as a motive power, especially in the field of heavy traction.

LETTERS TO THE EDITOR

Condict Series Multiple Controller Patent.

THE sustaining of the Condict patent on the series-multiple controller by Judge Townsend was undoubtedly a just and proper decision, and will be a most valuable asset to the General Electric Company and the Electric Car Company. The status of this matter is perhaps not fully known, and as it might be interesting to others outside of the railway car builders, I would make the following explanations:

The Hunter Electric Company in 1887 made a number of these series-multiple controller switches under the broad inventions of myself, the first of which did not use the resistance outside of employing the sectional windings or fields for this purpose. These features are all covered in patents granted to me, the broad series-multiple controller patent being No. 385,055, June 26, 1888. Another broad patent is 494,705, April 4, 1893. This company was organized by me under my electric railway inventions, and Mr. Condict was employed as superintendent at our works. Owing to the large current used the contacts were more or less heated, with danger of fusing, when the controller was moved slowly. To improve this, Mr. Condict, in connection with my work, added the supplementary resistance to overcome this danger and at the same time increase the possible regulation. The improvement was undoubtedly an excellent one, and, while specific, has proved to be universally approved and is used with very little modification on all controllers.

When the Hunter Electric Company later became known as the Electric Car Company of America, this became the standard form of the Hunter series-multiple controller. The Thomson-Houston Electric Company purchased from the Electric Car Company of America the exclusive license to all of the patents and inventions which it controlled (amounting to very large numbers), and among which was the particular Condict patent, upon which the court has recently rendered a decision.

R. M. HUNTER.

Philadelphia, May 26, 1898.

Fan Motors for Railroad Cars.

I AM always interested in the suggestions made from time to time in your editorial columns as to the uses to which electricity can be put. Since the coming of the warm weather I have noted the ever widening range of usefulness forecast for the fan motor. A journey last year from New York City to the terminus of the New York Central railroad, en route to the Adirondacks, where I hoped to find the fresh air and quiet denied the denizens of large cities, was almost unbearable on account of the heat and foul air. In order to prevent a completion of the broiling and stifling process, the windows were of necessity opened, and, although carefully screened, the indraught of dust and cinders that followed increased physical discomfort to such a point that endurance seemed no longer possible. At the end of the railway journey, in common with my fellow travelers, I was in a condition of utter exhaustion and nerve irritability. During the long, weary hours of the day, when St. Lawrence's position on his gridiron seemed an enviable one, I cast about in my mind for some device which would make summer traveling tolerable. Electric fans suitably placed immediately suggested themselves as a solution of the problem. Involuntarily my fingers sought the magic button and as in imagination I felt the cooling breezes, I determined to give the thought to the Engineer for dissemination. Storage batteries of requisite ampere hours could be utilized as a source of e. m. f. They could be exchanged for freshly charged accumulators at necessary points along the line.

Nothing would invite to summer travel as the equipment of the passenger coaches of the railways throughout the length and breadth of the land with efficient fan motors. In this way the annoyance of hot, foul and dust-laden air would be avoided.

If, in addition, upholstered seats could be universally replaced with those of wicker or rattan, the invalid and those who do not bear well the discomforts of travel would find it a temptation to escape from the heat and turmoil of the city to the cool and quiet retreats of mountain and sea.

MARGARET A. CLEAVES.

New York City.

LITERATURE

THE 1898 EDITION OF "THE MINERAL INDUSTRY."

The well-known annual entitled "The Mineral Industry," which will soon appear for the sixth time, will contain complete statistics of the mineral and metal production of the United States in 1897, collected with infinite labor and care, and at much expense. The mineral and metal productions of the United States in 1897 here recorded were the largest in the history of this or any other country. They almost equal in value the production of all Europe. The economic details published in "The Mineral Industry" volume show that the United States is rapidly attaining the point where it will be the greatest exporter of minerals and metals of all the commercial nations. The editor, R. P. Rothwell, C. E., M. E., and the "Engineering and Mining Journal," are to be congratulated on this admirable production.

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Notes on the Chicago Electric Light Convention.

THE Chicago convention has come and gone, and while there has been larger attendance, we cannot in any instance recall a larger number of listeners to the papers read, or more earnest discussions. By stating that the number of attendants was not so great, we do not mean to imply that there was a smaller number of central station men than usual. On the contrary, they exceeded in number those at many previous conventions, the smallness in the aggregate number being due to the absence of many of the supply men who have heretofore served to brighten conventions with their presence.

It was understood from the start that President Insull intended this convention to do convention business first, and other things afterwards, or not at all—and this programme was strictly adhered to. The consequence was that at no time during the entire proceedings of three days were there less than two hundred auditors in their seats, while at times, the large Banquet Hall of the Auditorium Hotel, seating four hundred, was filled to its utmost capacity. This is a most remarkable manifestation of continued interest in the work of the association.

The main features of the convention work may be considered to have been municipal ownership, and the alternating vs. the direct current. Who would have supposed that the latter, almost forgotten, topic would have occupied a whole day of the convention's time, claiming two sessions and being perforce curtailed for lack of time. Yet such was the fact. The gauntlet was thrown down by Mr. Wagner who stood as the champion of the alternating current, and more particularly for the single-phase alternating current. His case was well presented, and the figures contained in his paper were well marshalled. Mr. Ferguson's paper, on "General Distribution from Central Station by Direct Current," although not designed to be a reply to Mr. Wagner, nevertheless, served that purpose very fully. After the reading of the papers a battle royal began which, as stated before, lasted all day. We rather opine that the direct current advocates had a little better of the argument, or rather that they had more facts and figures available to fortify them than their opponent. Still it may be fairly said that the battle was a drawn one, and that, judging from the expression of opinion in various quarters, the standard system of distribution of the future will be neither exclusively alternating nor direct, but a judicious mixture of both.

During the course of the discussion one or two points were touched on, which we think might well be brought home in these days of increasing power applications. We have heard, for example, that, as a rule, elevator work does not pay, owing to the suddenness with which the current demand comes on the circuits and the heavy drain and drop of the potential necessarily affecting the circuit. As was pointed out by Mr. Dow, elevator work was not to be despised, or rejected as an inconvenient load to the station, if for no other reason than that to reject such service was a direct incentive to the installation of private plants, which must in the end detract largely from the field of operation of the central station. It was evident if the owner of a building was forced to put in an elevator plant himself, he would employ an engineer, who could very easily look after an electric light plant at the same time. This is a very important point in our estimation, and will no doubt be acted upon.

As to municipal ownership, Mr. Dow's paper put the case very clearly indeed. He took for his text the experience of Detroit, and indeed no better example could have been chosen, if the author had wished to demonstrate the evil effects of useless competition for city lighting contracts; but in addition to that Mr. Dow analyzed the subject independently, and arrived at a number of conclusions. We are not prepared to agree entirely with all of these, but most of them are eminently practical, and some of them contain suggestions which are well worth considering and which may serve to stem the tide which now seems to threaten many central station properties. We shall print the paper in full with others on the subject. Throughout the discussion of Mr. Dow's paper there was noticeable an unmistakable undercurrent of opinion that much of the hardship to which many electric lighting companies have been subjected in the past, has been brought on either by their own carelessness, their inequitable dealings with the public, and by bad service. It would be well, therefore, to keep in sight the experience of such companies. It seemed to be generally admitted that the public, as a rule, is disposed to treat electric light companies fairly, but that it requires to be educated in order to appreciate the stand which the companies take on municipal ownership. It was generally conceded, too, that the association acting as a body could do much to aid individual members, and that while a campaign against municipal ownership might prove arduous and expensive to any one company, the association if properly supported by its members could accomplish a vast deal of good at a small expense to the individual members.

There is another point which for the good of the whole industry we deem deserving of especial attention, and that is the

suggestions that the companies get together and lay down a schedule for establishing a uniform system of keeping accounts, similar to that required by the Board of Trade for the English electric lighting companies. This point was well brought out in the paper read by Mr. Calvin W. Rice, whose analysis of the cost of the generation and distribution of a unit of electricity, we are grieved to say, was based almost entirely on English and continental European figures. One other point brought out in Mr. Rice's paper was the fact that the cost per unit of our railway plants was better than that of any English lighting station. We believe that the incoming president of the association can do the association no greater service than to set on foot the carrying out of the plan of having all members of the association tabulate their station statistics in a uniform manner. Why wait until forced to do so by a State Commission? And that brings us to the sentiment also expressed on the floor of the convention that State commissions governing gas and electric companies would be one of the surest means of curing the municipal ownership craze. In private conversation, delegates from Massachusetts, one and all praised the work of their State commission whom they looked to as their bulwark against unwarranted attack from every quarter. While this is a subject which might be the particular work of the State associations, the N. E. L. A. may well imitate the movement for the common good.

In conclusion we must felicitate Mr. Insull on the success of his administration and on the zeal with which the duties of his office have been discharged. The association exists to discharge very important functions, and these Mr. Insull has carried out, in some respects quietly and witn reserve, but none the less effectively. He hands the association over to his successor in admirable shape, secure on firm foundations; and all wish and expect for President Young a prosperous and useful term of office at the head of one of the most responsible and serviceable electrical bodies in the world.

The Study of Foreign Methods.

AN interesting exemplification of modern business methods is presented by the Special Commission that is to be sent abroad by the Edison Electric Illuminating Company, of New York, for the purpose of reporting on the methods in use in Europe for the generation, distribution and sale of current. The commission, which leaves in a few days, is composed of Mr. J. W. Lieb, Jr., general manager, Mr. J. Van Vleck, constructing engineer, and Mr. Arthur Williams, general inspector. It will be seen that these gentlemen represent the company in its various functions as an electricity supply concern, and that their reports, each supplementing the others, should cover thoroughly the whole field of operation, as related to the art and to the public. The commission will visit stations in England, Italy, Germany, etc., including those at London, Paris, Milan, Rome, Berlin, Hamburg, Vienna and Buda Pest, and may also go as far north as Stockholm. The enterprise of the Edison Co. is to be heartily commended, and is in line with the progressive tendencies that have always marked its work. We have been glad to note, moreover, the visit of English and foreign engineers to this country in increasing numbers of late to study American central station practice. This reciprocity is of the right kind and should be encouraged. There will always remain abundant reasons for diverging practice, but there are equally a number of important features of the work which can be made uniform through all countries, with manifest gain in the development and perfection of the art.

The Validity of City Contracts.

ONE of the most interesting passages of President Insull's weighty and memorable address in Chicago last week was that dealing with the question of public franchises, and advocating that the best protection for investment was an exclusive grant under proper conditions of control. The positions taken by Mr. Insull seem to us impregnable, as arguments for good service cheaply done. But there is a further point which we regard as coming within the lines of that part of his address. We refer to the frequent repudiation of contracts by city bodies after the local companies have, so to speak, staked their all in putting up plant to meet the requirements. This is an evil that must be grappled with. A case of the kind has just occurred at Houston, Texas.

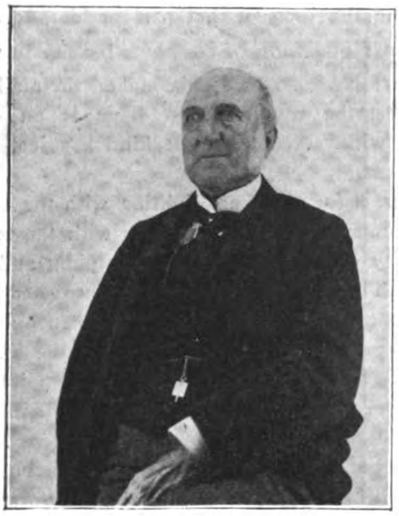
The city made a contract for ten years lighting with the Citizens' Electric Light Company, in 1894, and now with the term not half expired, the city wants to put in its own plant and to abrogate its contract. The City Attorney has furnished an opinion to the effect that he "does not think there can be any danger of the city being compelled to comply with the terms of this contract." He recites a number of cases, the point in each being that the city council has not the authority to make a contract for lighting the city in such a way as to prevent later councils from "carrying out the expressed will of the inhabitants of the municipality as to different and to them a better way of supplying lights to the city." One wonders what a contract is worth, anyhow! There is no question raised of fraud and none as to the service itself, but the whole argument is that the city has changed its mind and has a right to tear up its contracts every time a new city council is elected. We refuse to believe that such things are permitted under a right construction of the law. The implication and the possibilities of wrong to innocent people are too outrageous. We may note that one of the incidental arguments of the City Attorney is that the contract "is not binding because it is exclusive in its nature, and in the light of our decisions a monopoly and void."

It seems to us that here is a matter in which the members of the National Electric Light Association might well make common cause. If contracts are to be torn up whenever the municipal plant fever strikes a town, or for any other reason, it is time local companies knew it and made a new fight for the sacredness of contracts under the law of the land.

WE are glad to note that Dr. Louis Duncan has been gazetted a Major in the new U. S. Volunteer Engineer Corps, and Lieut. E. B. Ives as a Captain. Good service may well be expected from these gentlemen, so well known in the field of electrical engineering, and both of whom have enjoyed professional training either at Annapolis or at West Point. Of the electrical men already active in the war, good news comes of gallant work, particularly of those on board the Yankee, to which Lieut. S. Dana Greene was assigned with part of the Naval Reserve. The boys put up a splendid fight at the bombardment of Santiago the other day, and their behavior won the enthusiastic commendation of the whole fleet.

AS this issue of The Electrical Engineer goes to press, the President is expected to sign the bill providing for war taxation. Under this measure, each telegram will be taxed one cent and each extra territorial or long-distance telephone message one cent. It is estimated that these two items will yield an income of about $700,000 a year, which will about pay for one day's good fighting.

Closing Notes on the Exhibition.

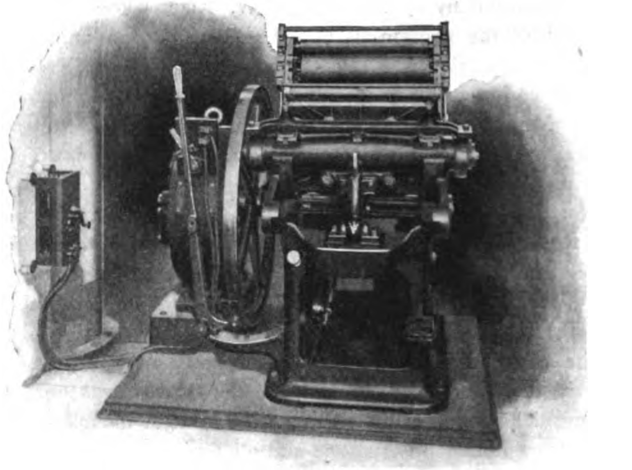

HON. CHAUNCEY M. DEPEW.
(Photographed by light of Moore Vacuum tubes.)

BEFORE the Electrical Exhibition at Madison Square Garden closed, the Moore chapel was visited by a number of celebrities, and among them was the Hon. Chauncey M. Depew, prior to his departure for England. While in the chapel he was photographed by the light of the Moore vacuum tubes. One of the pictures thus taken instantaneously is here reproduced, and will be recognized as a singularly faithful photograph of the "Grand Old Man of the Grand Central." After the photograph had been taken the public was admitted to the chapel and there another photograph was taken with success. Mr. Moore expressed the opinion that in future the vacuum tube would take the place of the flashlight and be far more agreeable to the victim. But the great immediate gain was the ability to secure a vacuum tube photograph instantaneously instead of in five minutes or several seconds at the best.

The amount of literature distributed at the exhibition was something prodigious. Thousands of copies of The Electrical Engineer were given away, and the other electrical journals were also free-handed in their distribution. At the Moore chapel literal hundreds of thousands of descriptive sheets were handed out, and tons of circulars were used by such concerns as the Electrical Engineer Institute of Correspondence Instruction, the New York Telephone Company, Elmer P. Morris, the Walker Company, the New York Electrical Society, the De La Vergne Refrigerating Company, Monarch Manufacturing Company, Diesel Motor Company and others. The Crocker-Wheeler Electric Company, for example, distributed no fewer than 25,000 copies of their handsome special bulletins, each number of which is a valuable special treatise on some branch of the electrical art. The literature of the New York Telephone Company deserves a special word of high commendation. It was very pretty and tasteful, was pithy and to the point and was so handy that it was always carried away and preserved by the recipient. The New York Edison Company also made a judicious distribution of literature relative to the various uses of current in the office and home.

Electric Printing at the Exhibition.

ONE of the most striking exhibits at the Electrical Exhibition was that made by the John Thomson Press Co., of this city, of one of their beautiful "half medium" Colt's Armory presses, style No. 2, driven by a Bullock direct connected motor at speeds of from 20 to 40 impressions a minute, or say 1,200 an hour, as operated at the show. We present here a picture of the exhibit, which was one of the features of the opening night, and which remained in operation through the month. The quality of the work done on the press was a matter of surprise to visitors who had not before seen it. On the opening and subsequent nights it ran off several thousands of the Postal Telegraph blanks, recording the work then done. This was followed up by a splendid Bartlett half-tone of Chief Engineer Melville, of the Navy, and by the famous Schussele-Sartain engraving of the "Iron Worker and King Solomon." But perhaps the chief hit was made with another exquisite Bartlett half-tone of Admiral Dewey. These various blocks were printed on plate paper, and were handed out as souvenirs of the exhibition, being sought


JOHN THOMSON PRESS AND BULLOCK MOTOR AT THE EXHIBITION.

after most eagerly, not only for their interest, but as choice specimens of the printing art. That the work was done with the aid of the electric motor speaks volumes for the smoothness of the running of the apparatus employed.

Habirshaw Wires and Cables at the Exhibition.

A VERY neat and quietly tasteful exhibit at the Electrical Exposition, just closed at Madison Square Garden, was that of the India Rubber and Gutta Percha Insulating Company, who had a space just to the left of the entrance, on the main floor, on the aisle between the Edison exhibit and that of the New York Telephone Company. The front of the space was occupied by a large show case entirely of plate glass, and a notable feature of the contents was the fact that all the samples exhibited were from actual orders and goods shipped. One conspic-

EXHIBIT OF THE INDIA RUBBER AND GUTTA PERCHA INSULATING CO.

uous item among the many Habirshaw specialties was a complete assortment of Niagara power-house bus-bars, which have been described already in The Engineer, and which are heavy copper tubes specially insulated. There were also regular cables of 500,000 c. m. to carry 20,000 volt current and a concentric three-conductor cable, each of 1,000,000 c. m. Samples were also shown of the 4,000,000 c. m. cable used in the Siegel-Cooper "Big Store," and of the large cables furnished for the Waldorf-Astoria plant, and for the new Delmonico. A variety of ordi-

nary cables, submarine cables, cables for torpedo work, and wires and cables for interior use, rounded out a most interesting exhibit that was closely studied by the expert and greatly admired by the general public. Messrs. Godfrey, Harrington and Olson were in constant attendance and Dr. Habirshaw himself paid the exhibition some visits with friends. While not large, the exhibit was so judiciously selected as to exemplify the widest range in electrical wire and cable manufacture.

Souvenirs Given Away at the New York Electrical Exhibition.

PERHAPS one of the most substantial evidences of the good will of the electrical fraternity towards those who patronize it or take an interest in its products, was the liberality displayed at the recent show in giving away valuable and useful souvenirs to visitors. Among these souvenirs should be mentioned the one-foot folding celluloid rulers of the Electric Storage Battery Company; the handsome buttons announcing that you had paid a visit to A. K. Warren and Company; a spirit level by the Borne Scrymser Co.; porcelain pin holders full of points on the products of the Peru Electric Manufacturing Company; miniature triple-petticoat insulators distributed by R. Thomas & Sons Company; nickel-plated drills in the form of watch charms by the Cleveland Twist Drill Company; wire charts and five dollar bills by Elmer P. Morris and the Adams-Bagnall Electric Company; the card board safety guns by the Safety Insulated Wire Company, as harmless as the miniature vacuum tubes distributed in the Moore Chapel; ebonite paper cutters, the gift of the Crown Woven Wire Brush Company; electrical periodicals which were much sought after, and useful note books given away by the enterprising New York Telephone Company, and handkerchiefs with name embroidered for a very small sum of money. Tea and biscuits, and strawberry short cake were dispensed in

THE NILES TOOL WORKS CO.'S EXHIBIT.

the Edison booth, catalogues and knowledge were given away gratis by everybody, and broken fingers, faces disfigured by X-rays, and other features not on the daily programme will ever remain fresh in the minds of the unfortunate victims as some souvenirs of the second New York electrical exhibition.

THE PHILADELPHIA ELECTRICAL EXHIBITION.

JUNE 6 TO JULY 6.

Opening the Exhibition.

WITH impressive ceremonies the Philadelphia Electrical Exhibition was formally opened to the public on Monday, June 6. For months the promoters of this enterprise had been diligently at work devising novel decorative effects and arranging special features, as well as seeking to demonstrate the limitless applications of the electric current. The approbation expressed by those who attended the opening exercises and the large audiences which have visited the exhibition during the past week were certainly convincing evidence that the efforts of the promoters had been crowned with success and that the show has come up to the expectations of Prof. W. D. Marks and its other promoters.

The exterior of the building at 818 and 820 Chestnut street, within which the exhibition is held, presents a very beautiful and dazzling appearance at night. The whole front of the building is ablaze with 61 Helios enclosed arc lamps, and immediately above the entrance is a large American flag, in flashing incandescent lamps. By the use of a commutator the lights are made to alternate in such a way that only every second lamp emits a light, but the change is so rapid and regular that the effect obtained is that of a flag gently waving in the breeze. In the window to the right of the main entrance is an American escutcheon outlined in miniature incandescent lamps, surmounted by a large eagle with spread wings. In the window to the left of the entrance is a windmill with revolving blades studded with colored miniature incandescent lamps. The interior of the building has been beautified by a lavish display of bunting draped on ceiling, pillars and walls, while all about the nooks and corners, where mirrors abound, are banks and festoons of flowers. Crowning the whole scheme of illumination are the individual displays in fanciful designs that mark the rivalry of the exhibitors.

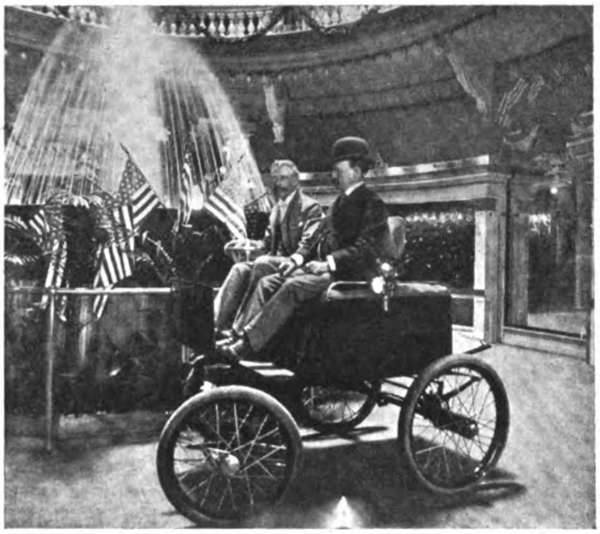
There are many interesting novelties shown at the exhibition. One of these is an electric fountain in the rotunda, shown in the illustration, which can be best seen from the gallery overhead. Multi-colored lamps set on a revolving horizontal table beneath the jetting water are switched on and off as they are set in motion producing a kaleidoscopic effect which is very pretty. Around the rotunda, on each side of the large mirrors, are four large panels, trimmed with natural plants, 500 fresh roses being used for this decoration every day. In order to preserve the roses for this brief period, each rose is placed in a small glass tube filled with water which is then slipped among the foliage interspersed with numerous incandescent lamps. The dome of the rotunda has two frescoes painted upon it, one representing the westward march of empire, the other the landing of Columbus. Carefully considering the patriotic feeling of the visitors the managers obliterated all traces of the Spanish standard which Columbus bore proudly aloft, by fastening an American flag over it, giving the worthy navigator the appearance of a traitor to his country. Around the rotunda are numerous incandescent lamps surrounded by holophane globes of varied colors, and on the gallery the First Regiment Band is seated, discoursing music every afternoon and evening. Another striking decorative feature on the main floor is a peacock of normal size in all its natural iridescence. The great tail is fully spread and on each feather sparkles a miniature light of the appropriate hue. In sharp contrast to this is a picture of a more sombre character. It is a full rigged ship, set in a frame, steadily making its way over the sea, under the light of the moon and of hundreds of stars. The ship tosses and moves, the waves rise and fall creating a very realistic impression. A number of novel effects in revolving lights are also shown which not alone attract but hold the attention of the spectators.

Another novel feature is an electrical cataract to which the whole of the second floor front is given over. It is an importation from Paris with elaborations by American genius. Upon a sheet of water falling through a distance of ten feet amidst beautiful scenery, pictures of flowers, statuary, flags, and pictures of naval and military heroes are projected and these stand out as though carved or painted in bold relief. Beautiful color effects are produced by slides operated by Mr. M. F. Oebbecke, who is in charge of the apparatus. Other features of interest, outside of the commercial exhibits which will be described later, are the X-ray exhibit, the Moore Turkish smoking room, the kinematograph war pictures and the Edison phonograph

exhibit, all on the second floor, and the Edison ore separation model, the Hunter exhibit and the welding machine in operation on the main floor. All these features and the general harmonious arrangement of the details reflect great credit on Prof. Wm. D. Marks, the director, Arthur Falkenau, consulting engineer, A. A. Lowry, treasurer, Guy King, architect, Arthur Organ, superintendent and W. Bartine, the electrical engineer.

The Kennedy Carriage at the Philadelphia Exhibition.

ONE of the most interesting features shown at the Philadelphia Electrical Exhibition and one which is attracting considerable attention, is the handsome electrically propelled vehicle exhibited by Messrs. C. W. Kennedy, F. A. Pocock and Ralph



THE KENNEDY CARRIAGE AND THE ELECTRIC FOUNTAIN AT THE EXHIBITION.

Ashley. The carriage is in constant operation in the exhibition hall, and has won the admiration of all by its ease of running, light construction and perfect control of speed and direction. Our illustration shows the carriage in front of the electric fountain, around which it makes its circuit many times during the day, to the delight of those who have the good fortune of being the occupants. The outfit embodies so many new and distinct features that a detailed description of its mechanical construction, the motor and the batteries, must certainly be of interest.

The wheels in front are 28 inches in diameter and 32 inches at the rear, and are equipped with Hartford single tube tires. A solid shaft, 1½ inches square, for the rear support, carries the rear wheels at each end, mounted upon the Rubber Tire Wheel Company's roller bearings, giving very low friction and a great length of surface, whilst they are dustproof. The rear springs are bolted solid onto this shaft, the rear upper ends being bolted to the frame and the front end being connected by a cross spring, which supports the battery weight exactly in its centre and distributes the load to a steel angle to both sides of the frame. The front wheels are made to do all the work, both steering and turning, in the lighter vehicles. The front wheels, again, support the machine by a 1½ inch diameter steel shaft, which is not broken by hinges or a differential gear, but runs right through both hubs, giving great strength to all the running gear.

The right-hand wheel is keyed to the shaft, which runs in two Mossberg-Granville roller bearings of ample length. The end thrust is taken up by three sets of ball bearings, one set outside each of the roller bearings and one set outside of the loose left-hand wheel. The bearing blocks are distanced and lined by a steel tube and carry the front springs, which are firmly held by one through bolt and are belted to the steering frame at the top of the springs. To the left of the left ball thrust the bevel gear of the differential is keyed to the shaft; the jack runs loose on the shaft with its large gear and four bevels. These transmit the power to the shaft through the bevel keyed to it and to the left wheel through a bevel belted to its hub. On the outside of this wheel is another ball thrust.

The steering frame is in this way connected directly with the front wheels, and the king bolt, which is situated far behind the axle, is a roller bearing. On this frame are three roller bearings, which support the main frame. By main frame for any class of work is meant the top of the gear, as applied of late to carriages. Anything that is put above this is a superstructure, and may be a delivery wagon or surrey. The running gear is completed up to this point. The king bolt being far behind the axle makes the body of this machine very light, and its tendency on the road is to go straight ahead. The driving of the front wheels allows the motor full power to lift the machine out of any hole it may get into, and at the same time to steer that wheel away from the least obstruction. The carriage also does not "weave," as the rear steering machines do. None of the ball bearings used in this machine are under pressure, all rollers and balls being only used for thrust.

THE MOTOR.—The motor is of the multipolar type, with a double armature and no external resistance. The speed and power of the motor is controlled entirely by different combinations of field and armature coils, which allow of a range of from two to eighteen miles per hour on the level. The power of the motor is in proportion to its speed, as in all series motors. The steering and control of such a combination is very nearly perfect, as demonstrated by the carriage in operation at the exhibition. The cells are always connected in series, and the full pressure of 44 cells is used with all combinations.

THE BATTERY.—The batteries are of special design of the Planté type. They consist of rubber trays one inch deep, with flaring sides set one within the other. The plates, which are lying at the bottom of each tray, are covered with sand, so as to preserve them in the proper position. Among the numerous advantages of these cells may be mentioned the small space they occupy; no possibility of buckling; large area of surface exposed; extraordinarily heavy charge and discharge rates; no slopping of the acid, and small weight. The entire combination makes a very light and easy-running machine, which can be turned almost within its own length. The same frame may be applied to delivery wagons or wagons for heavy traffic. The entire carriage weighs about 1,400 pounds, and with one charge of the battery 30 to 40 miles can be covered on good roads. With a heavier battery a range up to 100 miles on one charge can be obtained.

Mr. C. W. Kennedy has been in the electrical business in its various applied branches for 30 years and is well known to the members of the profession. He began as a train dispatcher and for a number of years was engaged in telephone work, being one of the old-timers, together with Edison, Delany, Catlin and others. He then devoted himself to railroad work and general engineering, and is now interested in the development of motors, storage batteries and automobiles for any kind of power.

Mr. F. A. Pocock, designer of the vehicle, will be remembered as the representative of the Thomson-Houston company when they started in the mining business, being a mining engineer by profession. The work put in by him at the Erie colliery near Scranton is still in active operation. This led to the Blossberg Coal Company's plant, for which he designed and built the "terrapin back" mining locomotive for the General Electric Company, he being at that time the consulting engineer for the mining department under Captain Griffin. The pumping plants put in around Scranton for the Pancast Coal Company, the Hillside Coal Company, the Connell Coal Company, which was the first mining pump on wheels built by the Gould company, Seneca Falls, N. Y., and equipped with T. H. motor, was followed by a larger pump in the Woodward colliery of the Delaware, Lackawanna & Western. Mr. Pocock then went back to mining work, built the plant of the Chamberville Coal Company, Pottsville, Pa., and two and a half years ago joined Mr. Kennedy in the electrical business.

Mr. R. Ashley, the electrician of this combination, is a self-made electrical engineer of wide experience. He has been associated with Mr. Kennedy for a number of years and has built for him two very efficient electric launches, 31 and 25 feet long, respectively, which have been in successful operation for over a year. The office of the company is located at 44 North Fourth street, Philadelphia, Pa.

A VERY COSY AND CONSPICUOUS space has been reserved on the main floor for the electrical journals, who at once took possession of "Newspaper Row" and are distributing and selling their respective periodicals as well as making the space their headquarters and a rendezvous for their friends.

Wilday Engraving Exhibit.

A very interesting exhibit is that of J. H. Wilday, 23 Duane street, New York, who has on exhibition and in operation one of his well known electric engraving machines with which he engraves on numerous articles on exhibition names or initials or special designs and patriotic emblems. In order to introduce this interesting machine Mr. Wilday offers to send a silver match safe with name engraved for 25 cents to any one who will send an order to the above office.

The Exhibit of The Edison Electric Light Co. of Philadelphia.

THE advantages of the liberal use of electricity for light and power are clearly demonstrated at the booth of the Edison Electric Light Company, of Philadelphia, illustrated herewith, which occupies a conspicuous place in the centre of the building. This company supplies all current furnished the exhibition building and the exhibitors. The methods of lighting shown are both artistic and practical. The sign work is displayed on the arch of the booth. The ordinary lighting is shown by every style of Edison lamp manufactured, exemplifying the difference in finish, shape, candle power and color. The working of the heating apparatus is not the least interesting. Cooking, ironing and heating are done before one's eyes. The fans exhibited at the Edison booth are as refreshing as they are novel and interesting; almost every style is shown, including the bracket fan, which has become quite a favorite.

The numerous styles of circuit breakers are both interesting

JOINT EXHIBIT OF THE EDISON AND BRUSH ELECTRIC LIGHT COMPANIES, OF PHILADELPHIA.

and instructive, and prove conclusively that the practical man of to-day is aware of the fact that "an ounce of prevention is worth more than a pound of cure."

The use of motors for practical shop work is shown here to advantage. The printing press and lathe shown at the Edison booth are doing every-day work; in fact, the press is turning out the literature that the company is distributing.

The meters shown are styles in every-day use by the Edison company—chemical and wattmeters. They are connected with a bank of lamps which are under control of a series of switches, clearly demonstrating the accuracy and reliability of these meters. The exhibit is always surrounded by a large number of interested visitors, and Mr. T. G. Seixas, the manager of the company, and a corps of assistants are kept busy answering the numerous questions asked.

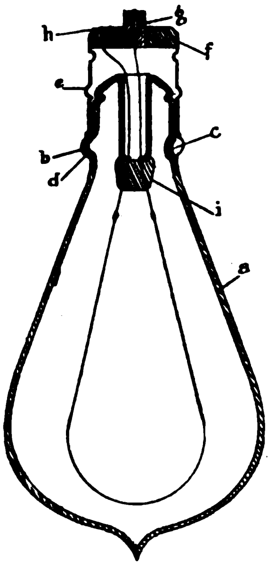
In a Taunton Tack Factory.

Among the prominent manufacturing firms recently adopting electricity for shop power is the Atlas Tack Company, of Taunton, Mass. A 150 k. w., 440 volt, 3,000 alternations Westinghouse three-phase generator has been installed, together with nine of the Westinghouse type "C" motors, for the operation of three large tack mills, extending for a radius of 1,500 feet about the power plant. The installation of this apparatus will enable the purchasers to shut down two steam plants, to cut out a great deal of long shafting, and to greatly increase the efficiency of the entire plant. Some twenty or thirty additional Westinghouse motors are to be installed in a short time, together with a 1,000-light Westinghouse dynamo.

NEWS AND NOTES

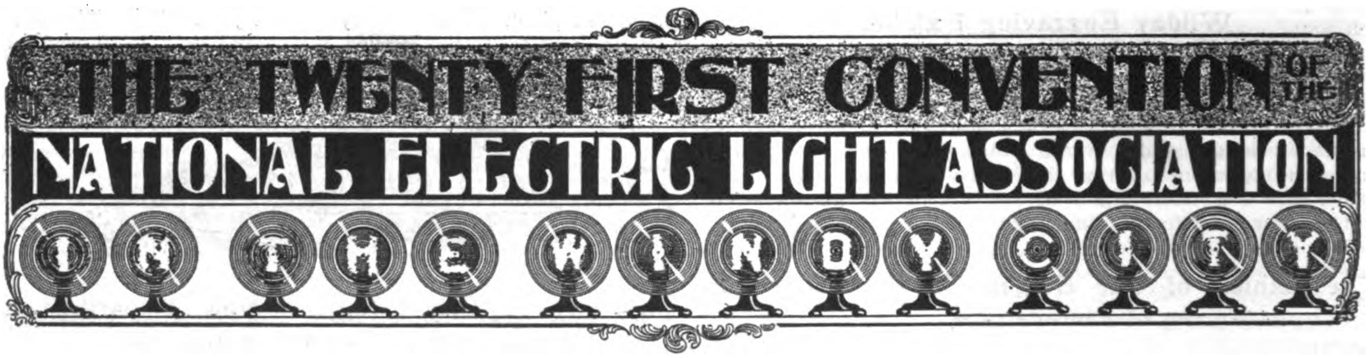
The 20th Century Lamp—A New Departure in Incandescent Lamp Construction.

OF late years so many new and varied styles of incandescent lamps have been placed on the market that volumes could easily be filled with the descriptions of the various types and the details of their construction. What may be considered, however, to be a radical departure from usual methods and one which appears to embody many valuable features, is the lamp manufactured under the Fowler patents by The Twentieth Century Lamp Works, 1031 Walnut street, Philadelphia, Pa., as shown at the exhibition. The main feature of this lamp is the satisfactory method of securing the bulbs in the bases, which will be best understood by reference to the figure below. In this figure the lamp a has on its upper portion an annular projection b with the notch c. Around this projection slips a split brass collar d which has an indentation to fit the projection b and also a small projection which fits in the notch c and pre-



20th CENTURY LAMP.

vents the collar from turning. Around this collar, which has an outward springing tendency, is slipped the base e which may be of any one of the standard styles. The upper portion of this base is closed by a porcelain disc f with a brass tip g in the centre to which one of the terminals is soldered, the other terminal being soldered to the base e at h. The leading-in wires are fused into a glass projection i in the usual manner. A drop of solder mechanically joins the collar d with the base e and prevents the latter from turning. This method, as will be seen, does away with the use of plaster of paris, making a mechanically strong lamp and one that will not work loose in the base, neither will it soak up or hold moisture which by electrolytic action eats away the inleading wires and short circuits the lamp in the base. In addition, these lamps have interchangeable bases and are especially adapted to street lighting, sign work, for use in damp places, and in places where lamps are roughly handled. The lamps are of very high efficiency and long life, with least decrease in candle power. The company have already received large orders for these lamps and those furnished have given entire satisfaction. Mr. G. M. DeGinther is manager of the company, and is a well known dealer in electrical supplies and novelties in Philadelphia.



Twenty-First Convention of the National Electric Light Association, Chicago, June 7, 8 and 9, 1898.

THE twenty-first convention of the National Electric Light Association was called to order at 11 a. m. at the Auditorium Hotel, Chicago, on June 7, by President Insull, who read the address printed elsewhere in this issue.[1]

Invitations and courtesies of various kinds were announced, including the free use of special telephones placed in the secretary's office by the Chicago and Long Distance Telephone companies.

Mr. Calvin W. Rice, of Brooklyn, then read a paper on the "Cost of the Generation and Distribution of a Unit of Electricity," in which he collated and summarized a variety of data on this subject. His conclusion broadly was that the total cost of plant was on the average $400 per k. w., and that the cost of operation per unit output per year was under 50 cents. "That is, on the average, it requires 50 cents worth of plant to generate and distribute one k. w. hour per year." Discussion arose as to the correctness of the statement in the paper that at the Budapest station, the gross watt hours per pound of coal were 575 and 571. This was attributed to the very high price and grade of the coal.

Mr. Creden—The Chicago Edison Co. generates a k. w. on about 4½ pounds of coal, equivalent to about 28 pounds, which gives an evaporation of about six pounds on an average to a day's run. Coal as used in Budapest would safely give about ten pounds on an average, which readily accounts for the large number of watts generated. The Chicago Edison Co. generates about 250 watts per pound of coal. The coal we use will give an evaporation of six pounds, perhaps a trifle less, on a run of 24 hours. The coal at Budapest is of a better quality and will give an evaporation of ten pounds, which will account for the high figure specified.

President Insull—I have here a chart which shows the average cost of various operations in connection with Chicago Edison operating expenses, except the interest portion of the operating expenses. The columns here show the interest charges with different character of load factors. I present this to you now as it is a matter bearing not only on my own remarks, made a short time since on the question of cost and selling price, but also upon the paper just read. These figures are taken from our actual balance sheet of the year. The largest amount of expenses is general expenses. The reason for that is that one-third of the expense is in getting new business, one-third administrative expenses, and the balance insurance, taxes and similar items. The biggest item of expense apart from general expense is, as Mr. Rice indicated, lamp renewals, when he referred to the question of regulation being more important than the question of economy.

The important point that the chart brings out is the interest cost. You might have all of your operating expenses presented to you outside of interest and then you could lose money—it would be possible to do such a thing if your selling price is not on the right basis. Here is a case of a 3.7 load factor. It is an office building, not an extreme case. I could show you cases where the load factor would be much poorer than that, but in that case the interest charge is 80 per cent. of the total operating charge. Here is a case of an ordinary fancy store—these cases are taken from the actual bills—and you see there that the interest charge is a little less. The importance of the interest charge in this case will be brought home to you when I tell you that the difference between six and five per cent. in the price you pay for your money and whether you sell your bonds at 90 per cent. or sell them at par, makes a difference of 16 to 20 per cent. in the cost of operating expenses. That statement alone will show you that the public (generally) is more interested than we are in the question of protecting us in the enjoyment of our right to do business.

Now we come to the all-night restaurant where the load factor is 48 per cent., the interest charge is only 26 per cent. of the total expenses. These are the two extreme cases I mentioned to you in my opening remarks. In one case you could sell current to a man at about a quarter what you could sell it to another man, and make more money out of one than out of the other. You will find that the same relation goes all the way through with the different classes of business. Power business is not quite as good as all-night lighting business. The load factor is about 35 per cent. and the interest expense 32 per cent. With a dry goods store the interest is about 40 per cent. With a small lunch counter the interest is 45 per cent., and with a saloon the interest is 52 per cent.

It is generally supposed that the best business is the power business. I remember in the early days, when the rates were established to foster the power business of the Edison Electric Illuminating Co., of New York, the claim was made that you could afford to sell power at one-half the price if your current was going to be used for power when it was not going to be used for light. We have found that the power curve and the light curve cross each other for 60 days during the winter, and the claim which was made for the power business proved a fallacy.

In the lighting business of people with large stations you can get a class of business which will yield you a bigger return on your investment from lighting customers than from power customers at a low rate, because the interest cost, if you have a 50 per cent. load factor, is only 25 per cent. of the total cost; whereas with power customers the interest is about 35 per cent. This chart properly studied should enable a man running the Chicago Edison Co. to make a price list that would fit all kinds of customers. If we can do that in our business, surely you can do it in your business. You will find, too, that the adoption of a system of rates that will take care of these different conditions, will affect various items very materially. It will not affect lamp renewals, of course. It will certainly affect station repairs, general supervision, station labor, fuel and also general expenses. In other words, it will affect by far the greater proportion of your expenses outside of interest charges, besides very materially affecting your interest charges, by putting your revenue on a basis so that it is in proportion to the interest you have to pay to take care of the customer whom you are supplying with current. You are putting your business on a basis so that you get a return on the investment which you have to provide for each separate customer. You may take an office building as a good business policy, but do not fool yourselves when you put on 5,000 lights in an office building, that you are necessarily going to make any money on them. We do the largest office building business in the country, and I am perfectly willing to say to you that I do not believe we make any money on it.

Mr. Ferguson—We take in Chicago every and any customer on that basis, and we have a uniform schedule of prices for everybody, based on one cent per lamp per hour; that is the base rate. We charge the full rate of one cent per lamp per

[1]See page 670 this issue.

hour for one hour per day as the maximum demand, and for all watt hours beyond that hour, we charge a half rate, 40 per cent. or 60 per cent., or anything you please. In regard to the question of what customers you can afford to take, that would involve a great deal of calculation. The simplest way is to charge a minimum bill to each customer, which will cover the smallest customer. If you charge a minimum bill for services furnished, that will cover interest and depreciation charges on the cost of the investment used.

Mr. Wagner—I understand that the Chicago Edison Co. is going to use the Wright demand system of charging, which is a very thorough way of providing for all these different classes of services. I should like to know if there is any one else here who accomplishes nearly the same thing by any other method?

Mr. Dow—I have been into this thing up to my neck in Detroit. I suppose that remark will interest a good many members here from small towns, say of 25,000 inhabitants. We have more than 25,000 people, but we have not money enough to buy Wright demand meters for all our customers just yet. We are going to do so some day. However, we use demand meters on a number of customers. We use them when there is doubt of arriving at the demand by any other means. We do not believe it necessary to leave them on continuously, but we put them on long enough to make certain that we have a fair average demand for the current twelve months, and in such cases we make the demand established by meter, and base a contract on it with the customer for the current twelve months. We say to them that they shall pay for that amount for twelve months, at the maximum rate, and everything beyond that at a minimum rate, and at the end of twelve months we will again meter in the same way, and reserve the right to put the meter on at any time to satisfy ourselves as to what the actual demand is. In some places we leave the meters on continuously. We would do so all the way through, but for the one point of not having money enough to put them on everybody.

Mr. Ayer—If there is any place in the world where a demand meter is a good thing it is in a residence. In the absence of the meter system in residences we have instituted a method of assessment according to the number of rooms in a house and the number of persons likely to use the light. We inspect each house and make a list of the rooms and the number of lights in each room; and we make a charge accordingly.

Mr. Ferguson—Mr. Dow made the statement that he could not afford to buy demand meters. He can do it after a while, but cannot afford to do it now. After listening to what he said I think he is much mistaken. I think he is spending too much of his valuable time in attempting to understand the personal characteristics of his customers. I am sure that if he does that properly, if he ascertains the characteristics of his customers so well that he can approach the work done by the Wright demand meter, he must employ a large force of assistants, and when we consider that the cost of demand meters is small in proportion to the total investment, and when we consider the immense amount of business that can be obtained by using the demand meters, I think he can well afford to buy them. With an instrument like the Wright demand meter you are put in a position where the instrument does for you what you will otherwise have to do by skilled labor at a very high cost. I say this from experience. For three years I have personally negotiated contracts for the Chicago Edison Co. on a basis similar to that described by Mr. Dow. I have had customers come into the office and talked with them to ascertain the conditions under which they burned their light, and made prices, with 15 and 25 and up to 65 and 75 per cent. discount, depending on the conditions under which they used the light. Since we have put in the Wright demand system the work is lessened, I am able to give my attention to other things and let the meter do the work for me. There are other ways, of course, at getting at the information and we have used them. We have used for instance the Bristol recording ammeter, which is useful for ascertaining the maximum load in any customer's premises. It is slow and can only be used in large installations, like hotels and theatres, where you desire to make a uniform discount for the entire year, which is practically the same as selling current on the Wright demand system. It is the load factor system; the only system based on load factor. If you know by the Bristol recording instrument that the load factor is 50 per cent., you can make the rate for the entire year at a uniform discount, which is the same as putting in the Wright demand instrument. It is tedious and much more expensive than buying the instruments and asking them to do the work for you.

Mr. Weeks—There have been few discussions before this association of greater importance to central station interests than that to which we have just listened. In the cost of our product the relative value of the interest factor has been forcibly and clearly shown, and the necessity for revision of rates or discounts has been ably demonstrated. In my judgment the method employed by Mr. Insull, or a slight modification of it, will soon come into general use. In one respect, however, the practice as stated strikes me of questionable equity, if not expediency, and I would like to ask what has been the effect upon your revenue of the lower rates for summer service.

Mr. Insull—We do not know yet. We only put it in operation during the last few weeks.

Mr. Weeks—It seems to me that it is somewhat inequitable to make a lower rate for transient summer service, such as that of the customer who operates a fan but a few weeks or months at most in the year, while his rate on account of the interest factor should be higher rather than lower than that for most other classes of service.

Mr. Insull—We have a large by-product that we want to sell, which usually lies idle in the summer, and we endeavor to dispose of it to these casual users.

Mr. Weeks—What has been the effect of the Wright system, which is admirable and will undoubtedly be the system of the future, upon municipal lighting?

Mr. Ferguson—The municipal light runs about twelve hours. It depends whether it is a moonlight schedule or an all-night service. It would not get as low as you are selling it now. You can readily see that if you make the rate 20 cents the first hour, and ten cents for everything after that, the maximum discount will not reach 50 per cent. It is something higher than that now. It is the same as if you figure 10 cents per kilowatt hour. You will have to make the second rate low enough, so as to figure out the same kilowatt hour as you are now charging for the arc light service. That must be arranged for in each individual city.

On motion the meeting adjourned until 3 o'clock.

TUESDAY AFTERNOON SESSION.

President Insull called the meeting to order at 3.10 p. m., and announced the first paper to be that of Mr. Alexander Dow, of Detroit, Mich., on "Public Lighting, with Relation to Public Ownership or Control."

Mr. Dow's paper was followed by papers on the same subject by Mr. Samuel Scovil, of Cleveland, Ohio; Mr. H. M. Atkinson, of Atlanta, Ga., and Mr. C. W. Davis, of Williamsport, Penn.

At the conclusion of the reading of the above papers the meeting adjourned to executive session.

WEDNESDAY MORNING SESSION.

President Insull called the meeting to order at 10.30 a. m. Papers were read by Mr. H. A. Wagner, of St. Louis, on "General Distribution From Central Stations by Alternating Currents," and by Mr. Louis A. Ferguson, of Chicago, on "General Distribution From Central Stations by Direct Currents." These papers, which are printed in this issue of The Electrical Engineer, were the subject of an animated discussion, which waged all day long and covered the whole field implied by the titles. The discussion was participated in by Prof. Fujioka, Messrs. Wagner, Ferguson, Thayer, Van Trump, Dow, Wilmerding, Prof. Goldsborough, Scovel, Pillsbury, Insull, Ayer, Fakes, Stetson, Davis, De Camp, Hubeley, Chandler, Smith, Carnes. An abstract of the discussion will be given in our pages next week.

WEDNESDAY EVENING SESSION.

Mr. Joseph Wetzler delivered a lecture on "Electricity Direct From Coal" before the Association, with the aid of a stereopticon and a large number of lantern slides. The lecture was well attended.

THURSDAY MORNING SESSION.

President Insull called the meeting to order at 10:40 a. m., when Mr. W. McLea Walbank, of Montreal, read a paper on "Cost of Producing Electric Power by Water Power From Lachine Rapids, Canada."

This paper gave figures with regard to a now familiar in-

stallation and gave a total cost per kilowatt on a 24-four hour basis per day, per year, of $22.97 per k. w.

The paper was discussed by Messrs. Wagner, Ferguson, Insull, Davis, Anderson, Matlack and others, the chief aim being to get at what Mr. Walbank had included in his costs. Mr. Walbank said that the price to a customer for 100 h. p. ten hours per day per working year would be from $32 to $36 per h. p. Mr. Anderson, of Springfield, Mass., stated that their plant gave them an e. h. p. for $21.23, delivered, with no allowance for depreciation, repairs or interest.

Prof. W. E. Goldsborough then read a paper on "Transformer Economy," dealing with general features of the subject. It was discussed by Messrs. Layman, Thayer, Wurts, Wagner, Davis, Matlack, Walbank and Huntley.

The president named Messrs. A. M. Robertson, James Dee and James I. Ayer as a nominating committee to select officers and members of the executive committee for the ensuing year.

THURSDAY AFTERNOON SESSION.

President Insull called the meeting to order at 2:55 p. m. The first business was the report of the committee on "Standard Candle Power of Incandescent Lamps," Dr. Louis Bell, chairman. Mr. Ayer presented the report of the committee as follows:

REPORT OF COMMITTEE ON STANDARD CANDLE POWER OF INCANDESCENT LAMPS.

Your committee has been able to have tested in the most careful manner, through the courtesy of Prof. W. L. Puffer, of Boston, sixteen incandescent lamps from eleven different makers. The lamps were obtained directly from the makers or their authorized agents and were known to be for test.

These lamps were all sold for 16 c. p., 110 volts, no watts specified, and may be fairly assumed to represent the product which would be shipped to consumers who did not desire the lamps for test, although one batch of lamps came with the bases marked to show the point to be turned toward the photometer screen.

On test, these lamps, 33 in all, averaged 14.1 mean normal c. p. and about 11.7 mean ph. c. p. Only one batch of three averaged over 16 normal c. p. One batch fell below 11 normal c. p. and two below 12 normal c. p. Five makers fell below 14.5 normal c. p. The highest average of any batch was 16.99, the lowest 10.82. The average consumption of energy was almost exactly 4 watts, the lowest 3.78 watts per candle and two batches ran over 5 watts. It should be noted that the voltage was determined by a Weston volt meter freshly compared with Clark cells and each lamp was marked at its marked voltage (110).

A separate series of tests showed that these lamps on the average gave their mean sph. c. p., when measured under rotation with their axes tilted 44 degs. and 24 min. from the vertical toward the photometer, thus confirming closely your committee's estimate of 45 degs. as a proper angle.

A series of tests on proper speed of rotation showed that the best results were obtained with a speed of 200 to 250 revolutions per minute, and that the lamps would readily stand this speed.

Many of the lamps showed bad spherical distribution, which seems to be quite needless since it is merely a matter of proper proportioning the form of the filament.

Of an equal number of batches of 32 c. p. lamps only one batch averaged 32 normal c. p., the majority falling to from 26 to 28 c. p. The 32 c. p. lamps averaged slightly greater efficiency, but were otherwise much like the 16 c. p. size.

From this investigation the fact stands out that the incandescent lamp sold for 16 c. p. is, on the whole, a lamp which is often giving considerably less than its rated c. p. even when new. Some of these lamps would probably show a temporary increase of c. p. after, say 50 hours' burning, but the committee has not extended the research in this direction as yet, and adheres to the opinion that the initial candle power is the only practicable commercial test, and any increase consequently is simply to be regarded as a device for keeping the lamp a little longer from its inevitable decay.

From these and other data kindly furnished by manufacturers and obtained from various other reliable sources, your committee is convinced that the need of a uniform rating is even greater than it concluded in the preliminary report of last year, and that a rating test in order to be effective must involve measurement of candle power of lamps in more than one direction. Neither mean horizontal nor mean spherical candle power, nor candle power in any one direction, will define a lamp well enough to insure adherents to the rating. Your committee therefore recommends that incandescent lamps be required to conform both to a standard mean normal candle power and to a mean candle power when revolved with the axis tipped 45 degs., this representing the spherical distribution. It recommends that the limits for the mean normal c. p. be 15 and 17.5 c. p. Unless the minimum be as high as 15 there will certainly be found a tendency to produce lamps near the lower limit. The 45 degs. c. p. should be at least 85 per cent. of this minimum. This is not an excessive requirement and will tend to prevent working near the lower limit of horizontal c. p. unless with a lamp very good in other respects.

Your committee has blocked out a standard form of photometer, a type of which it proposes to build, test and put at the disposal of the Association with directions for proper use.

It suggests that testing be by sample, a lot of ten lamps being taken from each barrel. Of these no lamp when run at its marked voltage shall show less than 15 or more than 17.5 c. p. mean horizontal, when rotated at 200 to 250 revolutions per minute; and no lamp shall give when thus rotated at 45 degs. inclination less than 85 per cent. of the above minimum.

The committee will make arrangements for standard lamps as indicated in the preliminary reports to go with the standard photometer.

Mr. Burleigh moved that the report of the committee be adopted, that this committee be discharged and another committee be appointed to continue the work. Motion carried.

PREST. A. M. YOUNG.

(Mr. Young is president of the New England Engineering Co., and is actively interested in a number of electric lighting and railway enterprises. He began his electrical career as a telegrapher.)

The president appointed as a committee: Chairman, James I. Ayer, of Boston; Louis A. Ferguson, of Chicago, and Calvin W. Rice, of Brooklyn.

The Committee on Amendments to Freight Classification requested further time to report, and the report was postponed until the next meeting.

The Committee on Legislation Concerning Theft of Current made an oral report, in which they stated that the committee had collected laws passed in twenty-seven different States bearing on this subject and they recommended that the same be published for the benefit of the members of the Association. The recommendation of the committee was adopted, and a new committee was formed, as follows: Chairman, E. A. Armstrong, of Camden, N. J.; James I. Ayer, of Boston, and A. W. Field, of Columbus, O.

The meeting then adjourned to executive session.

The report of the secretary and treasurer was presented, showing the affairs of the Association to be in a flourishing condition.

Mr. Armstrong moved the following resolution: "Resolved: That the annual meeting shall be held in May or June in each year, alternately in the cities of New York and Chicago, unless otherwise directed by the executive, and on such date as the committee shall determine." Adopted.

Mr. Atkinson moved, and a very hearty vote of thanks was passed, to President Insull for his untiring efforts for the success of the Chicago convention.

Mr. Ayer moved that the thanks of the meeting be extended to the Chicago Edison Company, the Metropolitan West Side elevated road, the South Side elevated road, the Northern Steamship Company, the Chicago Telephone Company, the American Telephone and Telegraph Company and all others who had extended courtesies to the convention for their kindness in so doing.

Mr. Field moved a vote of thanks to the reception committee for their very considerate attention to the ladies accompanying the delegates to the convention.

The following officers were elected for the ensuing year: President, A. M. Young, Waterbury, Conn.; first vice-president, E. H. Rollins, Denver, Colo.; second vice-president, F. A. Gilbert, Boston, Mass.; members of the executive committee, Samuel Insull, Chicago, Ill.; Samuel Scovil, Cleveland, O.; H. M. Atkinson, Atlanta, Ga.; F. A. Copeland, La Crosse, Wis.

The convention then adjourned sine die.

Convention Entertainments.

On the evening before the opening of the convention a reception of the visiting members was held in the Auditorium parlors. President Insull, aided by the members of the reception committee, received the guests, many of whom were attended by ladies. The occasion served to assemble many who had not met in years, as the choice of Chicago brought out many members who had been prevented from attending the recent meetings in the East. An excellent band furnished music and after refreshments had been served, dancing was the order of the day.

For those for whom dancing has no charms, the committee had provided a retreat in the Auditorium club rooms, nearby. There the gentlemen discussed central station matters, as well as some other things, and it was in the small hours of the morning before the discussions ended.

The ladies, as usual, were not neglected, and their comfort and entertainment were exceedingly well looked after, due to the kind attentions of the Chicago ladies. On Tuesday a ladies' coaching party drove through the South Side parks, stopping at the Washington Park Club, where a sumptuous luncheon was served. Unfortunately, a heavy thunder storm marred somewhat the pleasure of the occasion, but the weather could not dampen the high spirits of the party. On Thursday afternoon the ladies were taken for a drive through Lincoln Park and along the north shore.

Inspection of the Sprague System—Chicago South Side.

On the invitation of the Sprague Electric Company a number of the convention delegates on Tuesday night inspected the workings of the South Side elevated railroad, a special train having been placed at their disposal by President Carter, of the South Side company, under the immediate charge of Superintendent Morrison. The train was made up of brand new cars and all the appointments were of the highest order of excellence and beauty. The train was put through a number of severe tests, showing in a marked degree the great value of the Sprague multiple unit plan of electric train operation. It was run at variable speeds and stopped and started at various depots. The acceleration tests at starting were the subject of particular comment, as they showed how remarkably fast a train can be brought up to speed from dead rest on the Sprague system.

The trip lasted one and one-quarter hours and gave great satisfaction to all who were present. Besides the members of the National Electric Light Association there were also present members of the Illinois Street Railway Association; Mr. Albion T. Lang, of Toledo, O., and Mr. David Belden, of Aurora. The Sprague company was represented by Messrs. E. H. Johnson, Charles A. Benton and W. H. Sheppard, the last of whom has had immediate charge of the work of equipment for the Sprague company.

JAMES C. WORMLEY & CO., Chicago, exhibited a full line of incandescent lamps of 2 to 250-volts, ⅕ to 50 c. p., as well as a line of filaments, from raw state to flashed carbons, ready for use. Their exhibit in parlor 132 contained also a handsome display board, showing about 60 lamps burning, no two alike.

Convention Notes.

COL. S. G. BOOKER was in attendance at the convention and looked after the interests of the Phoenix Carbon Company, of St. Louis, with his usual good humor.

THE OKONITE COMPANY, of New York, was represented by Captain W. L. Candee and Mr. George T. Manson, who looked after the interest of the delegates with their usual warm hospitality. Their Louis XV. plaques were the handsomest advertisements ever distributed at a convention.

WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., occupied suite 622. Their rooms were tastefully decorated with framed half-tones of the many kinds of generators, etc., installed in different plants throughout the country. In attendance was Mr. E. H. Abadie, manager of sales department; Mr. H. A. Wagner was also in attendance.

SAWYER-MAN ELECTRIC COMPANY, Pittsburg, occupied parlor 106. This company had a very neat showcase, in which were displayed a full line of plain and colored incandescent lamps of various voltages and candle power. The exhibit was in charge of Mr. F. S. Smith, the manager of the company, Mr. C. A. Ross and Mr. F. D. Rusling.

JOHN CHILD, 1563 Monadnock building, Chicago, representing A. O. Schoonmaker, of New York, brought his mica to the front. He resorted to the clever idea of suspending a large piece of mica over the stairway leading to the main corridor of the Auditorium. The card was a drawing one and was seen by all visitors at the convention.

PORTABLE ELECTRIC LIGHT COMPANY, of 1242 Marquette building, Chicago, showed a line of portable electric lamps for bicycles, carriages, house and factory use, as well as electric lighting apparatus for medical and surgical use. The instruments are something entirely novel, consisting of otoscope and laryngeal sets for examinging throat, ears and other organs. They exhibited also a gold bicycle lamp fastened to a silver-plated bicycle.

KIELY & MULLER, 7-17 West Thirteenth street, New York, exhibited their Climax damper regulator on the main floor of the Auditorium. A handsome working model, as well as a sectional model of this device, was shown, and was viewed with interest by a large number of visitors. The exhibit was in charge of Mr. Timothy Kiely, assisted by Mr. C. F. Mitchell and their Western manager, Mr. George E. Boylston.

L. A. CHASE & CO., 161-163 Forthill square, Boston, exhibited their improved Chase knockout junction boxes, also their new direct current circuit breaker. Great interest was shown in L. A. Chase & Co.'s specialties, a great number of descriptive circulars being carried away by visitors to the convention who were impressed with the decided improvement in their individual specialties. Mr. Sears Condit, of the firm, had charge of the exhibit.

WESTERN ELECTRIC COMPANY, Chicago, occupied room 4 of the main floor. They exhibited their Standard Western Electric fan motor, also a showcase containing a full line of Sunbeam lamps of various voltages. In practical operation was shown also their improved arc lamp, which, with the others, attracted quite a number of visitors. In attendance at their exhibit we noted Mr. C. D. Crandall, manager of the company; Mr. A. L. Tucker, manager of the supply department; Col. G. L. Beetle, L. K. Comstock, J. W. Ebert, Thos. G. Grier, Chas. Wilkinson and J. L. Jackson.

D. & W. FUSE COMPANY, Providence, R. I., had an exhibit of their non-arcing fuse in the main corridor of the Auditorium. The exhibit comprised a full line of fuses for both low tension and high tension service, together with the fittings for the same, manufactured by this company. These fuses have now been on the market for over a year and have demonstrated the claim made by the D. & W. Fuse Company as to their accuracy and reliability under all conditions. Their telephone protectors have met with great favor and have been very extensively installed throughout the country.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., occupied parlors 104 and 106, on the main floor. The rooms were tastefully decorated with American flags and on the walls were framed half-tones of the company's installations of all kinds of electrical apparatus, especially large generators. Pamphlets dwelling upon their entire

line of manufacture were presented to all visitors to their parlors. In attendance we noted Mr. F. H. Taylor, sales manager; Mr. Arthur Warren, Mr. Alexander J. Wurts, Mr. A. S. Morris, Mr. W. S. Rugg, Mr. Henry Floy, Mr. C. W. Register and Mr. Maurice Coster.

MR. C. F. MUNDEL represented the Davis Electrical Works, of Springfield, Mass.

PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., was represented by Mr. R. C. Bouslog, who had some interesting samples of their well-known china goods to distribute.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, was represented by Mr. A. C. Garrison, who had no exhibit, but had a lot of valuable information to give away on the subject of incandescent lighting.

THE INDIANA RUBBER AND INSULATED WIRE CO., of Marion, Ind., were represented at the convention by their popular secretary, Mr. R. E. Lucas, who reported that business was never better than at present.

MR. C. G. PERKINS represented the Perkins Electric Switch Company, of Hartford, Conn.; Mr. J. H. Reid, the Pittsburg Glass Company; Mr. A. Smith, the firm of Keelyn & Smith, Milwaukee, and Mr. E. R. Grier, the Bryant Electric Switch Company, of Bridgeport, Conn.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, occupied the large suite 126 in the Auditorium. The walls of the rooms of this company were hung with quite a number of pictures showing the installations in many stations undertaken by the Electric Storage Battery Company. A large attendance of visitors to their rooms were presented with catalogues and pamphlets. They were represented by Messrs. H. Lloyd, J. Appleton, J. R. Williams, F. H. Clark and L. B. Daggett.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, of New York, was represented by Mr. S. Marsh Young, who had on exhibition for the first time their new types of "Manhattan" lamps for direct current and alternating circuits. One of the new features of the direct current lamp is that it can be used singly in 220-volt circuits, by a simple change of the magnet. These new Manhattan lamps have been simplified, and Mr. Young had on exhibition the detail parts of the lamp which showed conclusively to those interested the great improvements they have recently made in lamp construction. A full and illustrated description of these lamps appears in this issue.

STERLING ARC LAMP COMPANY, 214-222 West Twenty-sixth street, New York, occupied parlor 1162 of the Auditorium Annex. Their exhibit comprised a rack of seven Sterling enclosed arc lamps, shown in neat and artistic designs. These lamps are built to burn on all circuits. A specialty shown were their series lamps 6½ and 9½ amperes, 65 volts, which created unusual interest among the many central station men visiting the company's room. A neat advertising souvenir in the shape of a lead pencil and cigar cutter combined was presented to the visitors. Mr. R. J. Randolph represented the company at the convention, the rooms showing his artistic taste, being decorated with American Beauties and La France roses. Needless to say, he had many lady callers.

SPRAGUE ELECTRIC COMPANY, New York, occupied a large suite of rooms and had a full line of literature on their new Lundell slow speed motors, especially adopted for all classes of direct connected work. Among the specially attractive and effective literature of this company we mention their '98 "Lundell Fan Motor Catalogue," their pamphlet on "Electric Motors in the Art of Printing;" also the first issue of their new "Architects' and Engineers' Electrical Bulletin." The last publication will from now on be issued monthly, being of especial interest to the parties for whom intended. The company showed a most attractive exhibit of Lundell fans, located prominently all over the Auditorium Hotel, supplying cool breezes throughout the building. The company was represented by Mr. Ed. H. Johnson, the first vice-president and general manager of the company; W. H. Sheppard, Mr. C. A. Benton, general sales manager; Ed. B. Kittle, Chicago agent, and Mr. M. B. Kitt. This being Mr. Johnson's first visit to the convention after several years of absence, his large circle of acquaintances were very glad to greet him.

STANDARD UNDERGROUND CABLE COMPANY exploited their cables and wires in room 134.

THE H. B. CAMP COMPANY, of Aultman, O., had its ever popular representative, Mr. Daniels, on the ground, who talked up underground conduit in his usual able manner.

MR. CYRUS O. BAKER, JR., master of transportation, was elected an honorary member of the National Electric Light Association at the Chicago convention. The honor is well deserved and has been more than earned by long and devoted service to the Association.

EUGENE MUNSELL & CO. and the Mica Insulator Company, of New York and Chicago, were represented by Mr. Chas. E. Coleman, manager of the two concerns in the West. The companies' blotters were distributed freely at the writing rooms and various headquarters of the different companies represented at the Auditorium during the convention.

J. HOLT GATES & CO. was represented at the convention by J. Holt Gates, Geo. B. Foster and C. H. Philbrook. This firm handles the apparatus of the Walker Company, of Cleveland, O.; of the Wagner Electric Manufacturing Company, of St. Louis, Mo., and the Card Electric Company, of Mansfield, O. They report the sale last month of 1,900 k. w. of generators, besides numerous switchboards, street railway equipments and other electrical details.

THE WALKER COMPANY, of Cleveland, was represented by J. Holt Gates, Geo. B. Foster, C. H. Philbrook and F. H. Talbot, of the Chicago office. Many of the delegates were interested in the new alternating system of the Walker company, as well as its new solenoid blow-out controller, also the "L" type of street railway motor of 150 h. p., 20 of which are being supplied the Metropolitan elevated railroad of Chicago. Many of the visitors called at the new station of the Chicago City railway, which is designed for 15 880 k. w. Walker rope-driven generators.

BISMARCK, the great German statesman, remarked to Mr. H. H. Brooks, upon a recent visit to the old country: "My dear sir, do not think of giving up smoking. When will you think?" This little remark has borne its fruit at the National Electric Light convention. Mr. Brooks wants his friends to think about him, and especially about Circular Loom, so to aid those who had acquired the habit of thinking, he presented to visitors a beautiful briarwood pipe, a box of "never-blow-out" matches and a bag of Durham smoking tobacco. On the lid of the box enclosing this most acceptable souvenir was the inscription: "Smoke Up With the American Circular Loom Co., Chelsea, Mass. Flexible Conduit Electroduct." While the fragrant smoke is wafted towards the azure vault of heaven, as the sturdy wireman trudges along with his load of 200 feet of circular loom on his shoulders, he will think, and Mr. Brooks and his company may be assured that the thoughts will be pleasant ones. And when in the fading hours of the day the station manager takes his well-earned rest, with his child upon his knee and his briar in his mouth, the sweet incense from the mellow weed will rise in praise of the worth of the American Circular Loom.

THE GENERAL ELECTRIC COMPANY was represented at the convention by the entire selling staff of its Chicago office and by several representatives from its other sales offices. It made no exhibit, but parties of delegates were made up for the purpose of visiting the different great stations in Chicago equipped with the latest types of General Electric apparatus. A large delegation accepted Mr. B. E. Sunny's invitation to visit the large store house and repair shop which the General Electric Company has established in Chicago, for the purpose of facilitating its relations with the customers in the great territory covered by the Chicago office. The General Electric Company made its headquarters at the Auditorium Hotel in room 140, which was tastefully decorated with palms and ferns. A supply of illustrated literature was also provided for those interested. The interests of the company were cared for by the following gentlemen: B. R. Sunny, F. N. Boyer, Theo. P. Bailey, J. Scribner, W. S. Arnold, W. J. Ferris, G. J. Cadwell, J. W. Buell, J. W. Johnson, E. C. Noe, O. E. Turner, A. J. Gifford, G. H. Atkin, H. T. Windsor, S. F. Dibble, W. H. Colman, J. J. O'Brien, P. A. Clisdell, Geo. D. Rosenthal, J. H. Livsey, W. F. Hays, W. J. Hanley, I. R. Prentiss, F. M. Kimball, H. H. Crowell, W. S. Andrews, J. Dalzell and A. D. Page.

THE ANCHOR ELECTRIC COMPANY, Boston, was represented by Mr. Norman Marshall.

THE LAKON COMPANY, Elkhart, Ind., manufacturers of transformers, etc., were represented by their president, Mr. John C. Boss.

HAYES & ARTHUR, of Cleveland, were strongly in evidence, Mr. Scott Hayes winning hosts of new friends for himself and his company.

OTIS BROS. & CO., New York, were represented by Mr. W. D. Baldwin, who had interesting information to give out on the subject of electric elevators.

CUTTER ELECTRIC MANUFACTURING COMPANY were represented by Mr. Henry B. Cutter, and showed up their I-T-E. samples and catalogue.

CHAS. A. SCHIEREN & CO. had their Western representative on the ground, Mr. A. W. Watriss, who looked after the interests of the delegates with great urbanity and incidentally talked up belting.

COL. SHAY, of the MUNSON BELTING COMPANY, distributed large numbers of war maps of Cuba, which were eagerly sought by the delegates, and proved acceptable souvenirs in these war times.

THE WASHINGTON CARBON COMPANY, of Pittsburg, was represented by Mr. J. S. Crider, who interested many of the delegates with valuable information on the subject of carbons for lighting and other purposes.

THE NATIONAL UNDERGROUND CONDUIT AND CABLE COMPANY, of New York, was strongly represented by Mr. J. P. McQuaide and Mr. Jackson, both of whom required no introductions to the delegates.

AMERICAN ELECTRICAL WORKS, Providence, R. I., was represented by its president, Mr. Frank N. Phillips, and its Chicago representative, Mr. F. E. Donohoe. Both gentlemen were constantly greeting their numerous friends.

THE STANDARD PAINT COMPANY, of New York and Chicago, were well represented by their Western manager, Mr. J. C. Shainwald, who had a neat little souvenir to give away in the shape of a manicure nail file. There are still a few of them left.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, was naturally in evidence at the Auditorium, though they had no exhibit there, Messrs. Low and Stacy being contented to circulate around among their numerous friends and entertain them with their usual well-known generous hospitality.

McKINLOCK & CAMP, of Chicago, were well represented by both members of the firm, who made a lasting impression on their many friends by their genial hospitality and pervading good humor. Both gentlemen were at the front in all the little entertainments usual at convention time.

THE VALENTINE CLARK COMPANY, of Chicago, was well represented by both members of the firm, who, by their universal politeness and geniality, made numerous friends among the central station men and interested them in their enormous facilities for shipping poles for all electrical purposes.

THE DEARBORN DRUG AND CHEMICAL COMPANY, of Chicago, were represented by their vice-president and general manager, Mr. Robert F. Carr, who interested many of the central station men in their elaborate laboratories for testing the water used in boilers, and in their various compounds for preserving them from incrustation.

AMERICAN CIRCULAR LOOM COMPANY occupied spacious room 1530 in the annex of the Auditorium. The firm was represented by genial Mr. Brooks, who received a constant stream of friends and visitors to the convention. Mr. Brooks also presented all callers with one of the best advertising souvenirs of the firm, consisting of a complete smokers' outfit—briar wood pipe, with pouch of best Durham tobacco and box of matches.

THE CENTRAL ELECTRIC COMPANY, of Chicago, decided to have no exhibit at the Auditorium, but had some large cards printed, giving a cordial invitation to visit their handsome new store, 264 to 270 Fifth avenue. Messrs. George A. McKinlock, Chas. E. Brown, C. W. Cobb, W. P. Upham and C. G. Burton were all in attendance, and many of the delegates took the opportunity to visit their store and to enjoy the cordial welcome always extended by this popular company.

List of Visitors at the Chicago Convention.

ATLANTA, GA.—H. M. Atkinson, J. H. Ely.
BALTIMORE, MD.—D. P. Robinson.
BAY CITY, MICH.—James G. Lowell, J. J. Thorne.
BELLEFONTAINE, O.—John M. Gregory.
BELLE PLAINE, IA.—George L. Thayer.
BELLEVILLE, ILL.—J. Frank Andres.
BIRMINGHAM, ALA.—J. M. Bradley.
BOISE, IDAHO.—J. W. Cunningham.
BOSTON MASS.—James I. Ayer, F. E. Barker, H. T. Edgar, Fred. M. Kimball, N. Marshall, George B. Neal, F. E. Smith, T. Ellwood Smith, D. F. Urquhart.
BROOKLYN, N. Y.—James Ferguson, C. W. Rice.
CAMDEN, N. J.—E. A. Armstrong, J. J. Burleigh, Walter E. Harrington, Mrs. Walter E. Harrington.
CHAMPAIGN, ILL.—B. F. Harris, Jr.
CHARLESTON, N. C.—F. A. Brooks.
CHARLOTTE, N. C.—W. T. Engel.
CHICAGO, ILL.—John Jay Abbott, W. L. Abbott, R. D. Allen, W. L. Arnold, G. H. Atkins, J. M. Atkinson, H. D. Babbitt, F. B. Badt, Edw. L. Barr, A. Bement, F. N. Boyer, W. G. Carlton, R. F. Carr, H. Cheney, Frank H. Clark, L. K. Comstock, George W. Conover, J. H. Cooke, Maurice Coster, J. R. Cravath, T. H. Creden, Harry H. Cutler, George Cutter, Fred. De Land, S. F. Dibble, J. W. Ebert, Charles M. Eddy, Louis A. Ferguson, W. J. Ferris, W. E. Finney, George B. Foster, Robert W. Francis, Jacob Frank, S. S. Frank, J. H. Goehst, Edward R. Grier, Thomas G. Grier, Edward M. Hagan, F. D. Hart, Jr., William S. Hine, H. R. Hixson, W. F. Hold, J. M. Hollister, Samuel Insull, George H. Jones, C. E. Kammeyer, W. F. Keily, M. B. Kitt, E. B. Kittle, J. M. Knox, G. A. Edward Kohler, C. L. Leibrook, Theodore Graham Lewis, T. Julian McGill, Charles Messer, H. B. Morgan, A. M. Morse, S. F. B. Morse, Charles B. Obermeyer, J. B. O'Hara, W. E. Pimlott, Charles A. Pratt, W. R. Pritchard, William D. Ray, C. A. Ross, J. Scribner, John J. Schayer, R. F. Schuchardt, J. C. Shainwald, J. H. Shay, William M. Smith, John Svenson, George Tailleur, H. L. J. Towner, W. P. Upham, A. W. Watriss, C. J. Wells, George S. Whyte, J. R. Wiley, C. D. Wilkinson, C. H. Wilmerding, H. H. Windsor, John Young, J. F. Conner, Thos. S. Gordon, M. E. Patterson, E. E. R. Tratman.
CINCINNATI, O.—W. J. Hanley, W. P. Hays, W. M. Hubbard.
CLEVELAND, O.—S. O. D. Johns, L. H. Rogers.
COLORADO SPRINGS, COLO.—E. E. Wade.
COLUMBUS, O.—A. W. Field.
DAYTON, O.—James C. Reber.
DECATUR, ILL.—J. H. Culver.
DENVER, COLO.—M. L. Stern.
DERBY, CONN.—Robert E. Wyant.
DES MOINES, IA.—R. H. Fraser.
DETROIT, MICH.—George W. Cate, Alexander Dow, J. H. Livsey, Joseph D. Lockwood.
DUBUQUE, IA.—William S. Mold, H. G. Torbert.
ELKHART, IND.—A. M. Barron.
EVANSTON, ILL.—E. W. Clark, J. B. Morrill.
FARMINGTON, ILL.—E. M. Rose.
FITCHBURG, MASS.—H. F. Coggshall.
FORT SCOTT, KAN.—C. F. Drake.
FOSTORIA, O.—J. B. Crouse.
FREMONT, O.—A. J. Blum.
HARTFORD, CONN.—C. G. Perkins.
HOUGHTON, MICH.—James R. Dee.
HOOPSTOWN, ILL.—C. H. Trego.
INDIANAPOLIS, IND.—C. C. Perry, G. O. Rockwood, C. H. Varney.
JACKSONVILLE, ILL.—J. P. Doan.
JANESVILLE, WIS.—E. P. Norcross.
JOHNSTOWN, PA.—J. W. Reeves.
JONESVILLE, MICH.—L. H. Gilbert.
KANSAS CITY, MO.—Edwin R. Weeks.
LA CROSSE, WIS.—F. A. Copeland, C. H. Greenwood.
LAKON, IND.—Gerald Mahony.
LOGANSPORT, IND.—Elmer Woodling.
LONDON, ONT.—Charles B. Hunt.
LOUISVILLE, KY.—G. Wilbur Hubeley.
MEMPHIS, TENN.—S. T. Carnes.
MILLEDGEVILLE, ILL.—P. Dull.
MILTON, PA.—W. W. S. Butler.
MILWAUKEE, WIS.—Thomas H. Ferris, Thomas R. Mercein.
MINNEAPOLIS, MINN.—Percy A. Clisdell, B. B. Downs, Henry Floy, A. M. Robertson.
MONTEREY, MEX.—E. Dystend.
MONTREAL, CAN.—R. S. Kelsch, W. McLea Walbank.
MUNCIE, ILL.—Hal. C. Kimbrough.
MUNCIE, IND.—O. Mitchell.
NASHVILLE, TENN.—Frederick S. Pratt.
NEWARK, N. J.—A. D. Page.
NEW BEDFORD, MASS.—Charles R. Price, George R. Stetson.
NEW ORLEANS, La.—W. M. Brooke, R. S. Stearnes.
NEWTON, IA.—A. C. Yates.
NEW YORK, N Y.—C. O. Baker, Jr., C. A. Benton, Willard L. Candee, Charles T. Child, T. E. Crossman, C. J. Field, Dr. William Habirshaw, George T. Jackson, Edw. H. Johnson, E. A. Leslie, George T. Manson, Converse D. Marsh, J. McGhie, James P. McQuaide, George F. Porter, Charles W. Price, Charles D. Shain, A. C. Shaw, Luther Stieringer, H. M. Swetland, Jefferson Wetzler, Joseph Wetzler, Mrs. Joseph Wetzler, Elmer E. Wood, J. E. Woodbridge, S. Marsh Young, John H. Dale.
NILES, MICH.—W. H. Tompkins.
NOBLESVILLE, IND.—A. F. Webb.
NORFOLK, VA.—Peter Wright.
NORTH EAST, PA.—A. L. Daniels.
OKLAHOMA CITY, O. T.—J. G. Fakes.
OTTAWA, ILL.—Douglas Hapeman.
PEKIN, ILL.—Thomas Cooper.
PEORIA, ILL.—G. G. Luthy, G. A. Scheeffer.
PHILADELPHIA, PA.—J. Appleton, Henry B. Cutter, Mrs. H. B. Cutter, A. J. De Camp, A. V. Dee, Herbert Lloyd, J. R. Prentiss, E. Ward Wilkins, John R. Williams, John Mustard.
PINEVILLE, KY.—F. D. Hart, Jr.
PITTSBURG, PA.—J. S. Crider, James F. Cummings, H. S. Smith, Frank H. Taylor, Arthur Warren, H. E. Webb, Alexander Jay Wurts.
PROVIDENCE, R. I.—L. W. Downes, A. W. Hutchins, F. N. Phillips.
QUEBEC, CAN.—F. H. Badger, Jr.
QUINCY, ILL.—H. O. Channon, C. G. Comstock, Thomas Holl.
RACINE, WIS.—P. H. Korst.
RED OAK, IA.—A. M. Miller.
ROCHESTER, N. Y.—George A. Redman, Mrs. Redman.
ST. JOSEPH, MICH.—W. Worth Bean, Jr.

ST. JOSEPH, MO.—Charles E. Roehl.
ST. PAUL, MINN.—H. J. Gille, C. R. Smith.
ST. LOUIS, MO.—E. H. Abadie, A. C. Garrison, H. H. Humphrey, J. E. Johannsson, W. A. Layman, E. V. Matlack, Edwin S. Pillsbury, Geo. D. Rosenthal, Herbert A. Wagner, H. S. Wells, C. Boettcher, E. S. Brinkman.
ST. PAUL, MINN.—Channing T. Gage.
SAULT STE. MARIE, MICH.—W. F. Kingan.
SAVANNAH, GA.—T. P. Keck.
SCHENECTADY, N. Y.—W. S. Andrews.
SEWICKLEY, PA.—J. W. Uptegraff, E. P. Young.
SHELBYVILLE, ILL.—E. F. Wells, R. S. Wells.
SIOUX CITY, IA.—C. E. Woodrow.
SPRINGFIELD, ILL.—Eugene Holcomb.
SPRINGFIELD, MASS.—H. S. Anderson.
SPRINGFIELD, O.—J. H. Miller.
STAMFORD, CONN.—Ronald Crawford.
STEUBENVILLE, O.—J. W. Hull.
SYRACUSE, N. Y.—H. H. Crowell.
TOKYO, JAPAN.—I. Fujioka.
TOLEDO, O.—W. S. Smith.
TORONTO, CAN.—F. C. Armstrong.
WARREN, O.—Elmer W. Gillmer, W. D. Packard.
WASHINGTON, D. C.—J. B. Lukes.
WATSEKA, ILL.—H. J. Frith.
WEST CHESTER, PA.—James E. Pyle.
WILKINSBURG, PA.—John J. Jennings.
WILLIAMSPORT, PA.—Ernest H. Davis, G. E. Wendle.
WILMINGTON, DEL.—Samuel N. Trump, C. R. Van Trump.
WINDSOR, CONN.—M. E. Baird.

SOCIETY & CLUB NOTES

The Trip of the "Northwest."

After the Chicago convention of the National Electric Light Association, about 100 of the delegates and ladies gathered on board the fine lake steamer "Northwest," which left Chicago on Friday, June 10, at 12.30 noon, to attend the convention of the Northwestern Electrical Association. Milwaukee was reached at 6 p. m. when the party was increased by further accessions from the Wisconsin electrical ranks. The trip promises to be pleasant and interesting.

PERSONAL

Mr. Frank J. Sprague.

It will be of interest to the general public, hardly less than to the electrical fraternity, to know that Lieut. Frank J. Sprague, who has for the last six weeks been confined to his house, and in great suffering, from a severe injury to his right eye, is in a fair way to recovery. Nearly two months ago a piece of the eyeglass Mr. Sprague was wearing was accidentally forced into the ball of the eye, and Mr. Sprague had to remain for some weeks under the care of a specialist. Being very anxious to push forward to definite shape the Volunteer Corps of Electrical Engineers, which he offered some time ago to organize for early service at the front, Mr. Sprague imprudently went to Washington, where he caught cold in the injured eye. Severe complications set in, along with iritis, and for some time it was feared that blindness was inevitable. This danger, however, seems to have passed, and there is every prospect that Mr. Sprague will soon be able to renew his active part, both in the affairs of the company with which he is identified and the formation of a fighting corps that should fill a place of its own in the war resources of the Government.

JAN SZCEPANIK, whose electrophotoscope was recently brought to notice, is said to have a new invention in which he utilizes photography and electricity in weaving so as to furnish designs for tapestries and to produce, for example, silk handkerchiefs with in-woven picture or portrait done on the spot.

LIEUT. E. B. IVES has been gazetted Captain the First Regiment of United States Volunteer Engineers, in which his military experience and especially his familiarity with signal corps work will make him very useful.

MR. G. C. SIMS, who is now on the U. S. S. Vulcan, as noted recently in our columns, was on May 28 raised to the highest grade in the Engineer Corps, namely, that of Chief Engineer in the United States Navy, with the relative rank of Lieutenant.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued May 31, 1898.

Alarms and Signals:—

ELECTRICAL SIGNALING SYSTEM AND APPARATUS. W. F. Banks, Milford, Conn., 604,712. Filed Oct. 1, 1896. Designed for "municipal" signaling systems. Details of construction.

SIGNAL FOR ELECTRIC RAILWAYS. W. H. Jordan, Brooklyn, N. Y., 604,866. Filed Feb. 16, 1897. A crossing signal designed to be operated by a moving car.

Dynamos and Motors:

ELECTRIC MOTOR OR DYNAMO. A. L. Riker, New York, 604,842. Filed Nov. 27, 1897. Embodies an enclosing casing having at one end an extension enclosing and supporting the brushes, and having a door in one side thereof to give access to them.

FORMER FOR WINDING ARMATURE COILS. A. L. Riker, New York, 604,843. Filed Nov. 19, 1897. Comprises two parts having a winding space between them, and winding channels in each part transverse to the plane of the winding space, those in one part being on the face of the former, and those in the other part in the rear thereof.

Lamps and Appurtenances:—

RHEOSTAT FOR ELECTRIC LAMPS. R. H. & F. H. WAPPLER, New York, 604,949. Filed Sept. 20, 1897. Adapted to be placed in the socket of an incandescent lamp to render it self-regulating.

Miscellaneous:—

ELECTRICAL BELT. A. J. Taylor, Vineland, N. J., 604,806. Filed April 12, 1898. An electro-galvanic belt comprising a sheath, hook-plates attached thereto, hinge-plates having electrical connection with the hook-plates, battery electrodes hinged to the hinge-plates and provided with removable fibrous pads, and a battery detachably connected to the hook-plates within the sheath.

SAFETY DEVICE FOR ELECTRIC CARRIAGES. R. T. D. Brougham and W. C. Bersey, London, England, 604,874. Filed Dec. 13, 1897. Means to prevent unauthorized persons from starting electrically-propelled carriages when left by the driver.

Railways and Appliances:—

ELECTRIC RAILWAY. J. H. Guest, Boston, Mass., 604,747. Filed Oct. 20, 1896. Comprises a trough-shaped contact-rail forming a working conductor, having supplemental contact-rails within the same, metal cross pins mounted on the sides of the trough and passing through the rails but insulated from them, and a filling of insulating cement in which rails and pins are anchored.

ELECTRIC RAILWAY. F. D. Sweet, Elyria, Ohio, 604,911. Filed Nov. 4, 1897. The continuous conductor is dispensed with and in its place a series of contact rollers placed at suitable intervals engage consecutively with a runner carried by the car.

AUTOMATIC CURRENT DISTRIBUTOR FOR ELECTRIC RAILWAYS. J. Clarent and O. Vuilleumier, Paris, France, 604,968. Filed May 4, 1897. Details of construction.

SWITCHING DEVICE AND CIRCUIT ARRANGEMENT FOR ELECTRICALLY-PROPELLED VEHICLES. E. B. W. Reichel, Berlin, Germany, 605,013. Filed Jan. 10, 1898. Embodies a contact-piece electrically connected with and actuated by the trolley arm, and adapted to be electrically engaged only when the trolley arm is in engagement with the trolley conductor.

ELECTRIC SWITCH FOR USE WITH ELECTRICALLY PROPELLED VEHICLES OR LOCOMOTIVES, ETC. A. T. Snell and C. E. Grove, London, England, 605,023. Filed Oct. 8, 1897. A compound switch comprising a starting switch and a controlling switch for coupling the motors in different relations, and mechanism for imparting an intermittent movement to the controlling switch from the starting switch.

THIRD RAIL UNDERGROUND ELECTRIC RAILWAY SYSTEM. L. E. Walkins, Springfield, Mass., 605,066. Filed Aug. 21, 1897. The third rail is contained within a conduit.

Telegraphs:—

PNEUMATIC ATTACHMENT FOR TELEGRAPH KEYS. W. J. Lieb, Pratt, Minn., 604,770. Filed April 15, 1897. Comprises an outer wall, a diaphragm, means for securing the device to a key button, and a tube leading into the air-chamber formed by the outer wall and the diaphragm.

Classified Digest of U. S. Electrical Patents Issued June 7, 1898.

Alarms and Signals:—

HEAT OR COLD INDICATOR. E. B. Petersen, Kearney, N. J., 605,129. Filed Aug. 11, 1897. Details of construction.

CALL BOX SYSTEM. E. E. Salisbury and A. E. Dean, Tacoma, Wash., 605,345. Filed June 22, 1897. A call box system in which a telephone is utilized.

SIGNALING DEVICE. F. B. Taylor, E. E. Salisbury and A. E. Dean, Tacoma, Wash., 605,358. Filed July 23, 1897. Means to enable an operator at a central office to automatically turn in any one of a number of outlying call boxes desired on a single circuit and at the same time signal the subscriber without disturbing any other subscriber.

RAILWAY SIGNALING AND SWITCHING APPARATUS. J. D. Taylor, Chillicothe, Ohio, 605,359. Filed March 24, 1897. An interlocking apparatus having means for preventing a lever changing its position in either direction before the track-switch has made its complete movement.

FOG SIGNALING APPARATUS FOR RAILWAYS. H. Tomlins, London, England, 605,361. Filed Nov. 22, 1897. Means to render

the operation and firing of the fog signaling apparatus automatically dependent on the position of the semaphore signal.

Batteries, Secondary:—

CONNECTOR FOR STORAGE BATTERY PLATES. G. Hart, Detroit, Mich., 605,424. Filed Jan. 13, 1898. Comprises an insulating base-bar, a lead plate superimposed upon it, connector plates alternately extending in opposite directions and resting at one end upon the lead plate, and screws passing through the connector plates and the superimposed lead plate into the insulating base-bar.

Conductors, Conduits and Insulators:—

INSULATOR. F. M. Locke, Victor, N. Y., 605,109. Filed April 23, 1898. Constructed of two or more porcelain parts fitted one into the other, and secured together, the inner part extending down to a point adjacent to the cross-arm, or resting upon the cross-arm, and forming a sleeve for the purpose of protecting the pin from static discharge of the current around the insulator.

INSULATOR. R. D. Mershon, Colorado Springs, Colo., 605,256. Filed Feb. 14, 1898. An insulator for high tension circuits having a long tubular petticoat adjacent to the supporting pin, and a short outer petticoat of much greater diameter, the edge of which is approximately the same striking distance from the cross-arm and the supporting pin.

Distribution:—

ELECTRIC TRANSFORMER. J. J. Bellman and C. T. Rittenhouse, New York, 605,194. Filed June 29, 1897. Comprises a ferromagnetic field built up of integral plates so mortised that when the plates are properly assembled the core of the magnetic field will be approximately circular in cross-section.

Electro-Metallurgy:—

PROCESS OF PRODUCING ALUMINUM SULFID AND REDUCING SAME TO METALLIC STATE. H. S. Blackmore, Mt. Vernon, N. Y., 605,380. Filed July 22, 1896. Consists in simultaneously convertng insoluble aluminum oxid into soluble aluminum oxid sulfid while in a molten bath and dissociating the soluble aluminum sulfid by electrolytical action.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. W. Hochhausen, Brooklyn, N. Y., 605,228. Filed Jan. 22, 1897. Details of construction.

SAFETY LOCK FOR INCANDESCENT LAMPS. E. Faller and H. Herbstritt, San Francisco, Cal., 605,279. Filed Sept. 17, 1897. Designed to prevent the surreptitious removal and stealing of incandescent light globes.

Measurement:

INSTRUMENT WINDING DEVICE. H. H. Wait, Chicago, Ill., 605,154. Filed Dec. 14, 1896. Comprises a chuck formed in two parts which are adapted to engage a core, each of the parts being provided with a lip, the lips being oppositely placed, the opposing surfaces of the lips diverging outwardly from the core receiving surfaces of the chuck.

Miscellaneous:—

INDUCTION COIL. A. L. Bogart, Jamaica, N. Y., 605,174. Filed April 22, 1897. A Ruhmkorff coil, combining the primary and secondary coils, a condenser arranged in the same plane therewith and partially enclosing the same.

ELECTRICAL VALVE CONTROLLING DEVICE. A. E. Colgate, New York, 605,197. Filed May 28, 1896. Employs a clock movement as the automatic circuit-controller for the whistle and a modified form of magnet for controlling the circuit to the clock movement and an improved weatherproof hand switch for controlling the apparatus at will.

ELECTRICAL APPARATUS FOR CHARGING FURNACES. J. P. Eck, Muncie, Ind., 605,090. Filed Aug. 12, 1897. Comprises two charging tracks, two trucks adapted to run thereon, a shaft for connecting the trucks, a hollow charging bar, an operating rod journaled in the ends of the charging bar, a cam formed at one end of the operating rod adapted to engage the shank of the charging pan.

Railways and Appliances:—

RAIL BOND. G. Moffat, New York, 605,115. Filed Feb. 24, 1898. Comprises two telescopically connected members, the members adapted for engagement with openings in adjacent rail sections.

TROLLEY SWITCH. J. H. Vanasselt, Seattle, Wash., 605,211. Filed Oct. 2, 1897. Comprises a switch plate provided with a keeper, a guide arranged at the under side of the switch plate and normally bearing against the guide, and a latch also arranged at the under side of the plate and connected with the switch point and adapted to engage the keeper and hold the switch point away from the guide.

TROLLEY WIRE HANGER. G. E. Johnson, Los Angeles, Cal., 605,251. Filed Aug. 19, 1896. Comprises an interiorly-screw-threaded cap; a plug of insulating material exteriorly screw-theaded and screwed on to the cap; a trolley-wire hanger having its stud secured in the plug; the rim of the cap being beveled outward and downward away from the plug to form a drip edge.

MOUNTING FOR THIRD RAILS. S. H. Short, Cleveland, Ohio, 605,260. Filed Nov. 5, 1897. A supporting bar for a third rail having bell-shaped castings at the end, insulating material arranged in the castings, and supporting standards arranged to be received in the insulating material.

THIRD RAIL FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, Ohio, 605,261. Filed Nov. 5, 1897. Combines with standards, a bar supported by but insulated from the standards, a third rail supported upon the bar, the rail presenting a side surface for contact with the collector and a strip lengthwise upon the rail and extending over the top edges thereof.

CONTROLLER. T. Von Zweigbergk, Cleveland, Ohio, 605,304. Filed Feb. 23, 1898. Combines with the controller shaft, a collar tightly surrounding the shaft and a trough below the collar and adapted to receive water passing from it and convey it beyond the controller.

ELECTRIC RAILWAY SYSTEM. W. Lawrence, New York, 605,317. Filed Dec. 1, 1897. Surface contact system.

TROLLEY CONNECTION FOR ELECTRIC CARS. J. G. McLaughlin, Brooklyn, N. Y., 605,326. Filed Dec. 28, 1897. Comprises a trolley pole, a swinging frame having cheeks extending upward above and beyond the extremity of the trolley pole, and a wheel mounted between the upwardly projecting cheeks of the swinging frame.

Switches, Cut-Outs, Etc:—

ELECTRIC SWITCH. C. C. Badeau, Schenectady, N. Y., 605,067. Filed Sept. 17, 1897. Knife switch for switchboard use.

ELECTRIC SELECTOR SYSTEM. T. C. Drake, Malta, Ohio, 605,309. Filed Feb. 26, 1897. Consists of step-by-step and unison mechanism which is operated and controlled in series.

Telephones:—

TELEPHONE SYSTEM. E. W. Ham, Worcester, Mass., 605,097. Filed Aug. 22, 1897. Intercommunicating telephone system.

TELEPHONE HOLDER. J. T. Moore, Minneapolis, Minn., 605,294. Filed Aug. 24, 1897. A pivotally supported lever, having a balance weight on one end and a telephone receiver clasp on the other end, with a telephone switch operating connection.

TELEPHONE SYSTEM. R. T. Reid and J. L. McDonnell, Tacoma, Wash., 605,341. Filed Sept. 25, 1897. Provides a simple and effectual lock-out device whereby the line can be restricted to the use of any one subscriber to the exclusion of the others.

THE STOCK MARKET

War a Waning Factor.

It seems to be assumed that war is now cutting little figure in the general course of events, and that Spain will be smashed anyhow, sooner or later, without too heavy an expenditure, and with some compensation in the shape of new territory and favoring markets. The stock market last week in 174 stocks saw rises in 95, declines in 62 and no change in 17. An event showing the drift of popular thought was the great Republican victory in Oregon on a flat, straight out, stand up fight for the gold platform, offsetting any silver talk in the Senate. Just at the moment, there is interest in the issue of the first war loan and the effect of war taxes. The grain outlook is good for railroad freights, although the estimates of 637,000,000 bushels of wheat or 200,000,000 more than last year, do not promise the maintenance of high prices.

During the week, 13,119 shares of Western Union were sold up to 92⅜, closing at 91⅝. Of General Electric 33,395 shares were sold closing at 38¾. In Boston, American Bell Telephone reached 275 on sale of about as many shares.

OBITUARY

Fred. A. Noll.

It is with extreme regret that we record the death of Mr. Fred. A. Noll, at the early age of 41. He was an active member of a family which has been prominently connected with the development of electricity in this vicinity, and had a remarkably wide circle of acquaintance in his chosen field of work. He was connected with the Edison parent company almost from the time of its formation, and had charge of its supply department. Later on, he was connected with the Edison Co. for Isolated Lighting, and still later with the Edison United Mfg. Co. He then became associated with the New York Edison Illuminating Co., having charge of the supply department, and he held the same post with the New York Electrical Equipment Co., which took over that branch. At the time of his death he was on the staff of the Sprague (Interior Conduit and Insulation) Co. It may be doubted whether anyone was better informed in regard to the various appliances used in electrical distribution and consumption. He leaves a widow, to whom and to the other members and relatives of the family universal sympathy and regret is extended.

HOUSTON, TEX. The city attorney has advised the City Council that the present contract with the Citizens' Electric Light and Power Company is not binding, in case the city wants to operate its own plant. The contract runs for ten years from 1894.

AMERICAN ELECTRICAL DIRECTORY, successor to the Standard Electrical Directory, is an excellent publication, giving statistics, complete and detailed, of electric lighting and railway work in America. It is issued by Mr. E. L. Powers, who is aiming to make it as accurate as possible.

MECHANICAL

Electric Mine Pumps.

DURING the past few years the greater number of pumps installed in mines have been electric, and, in fact, machines of this style are fast supplanting the steam pumps previously installed.

Many improvements in the construction of this class of machinery have fulfilled the demand for a pump embodying economy and convenience.

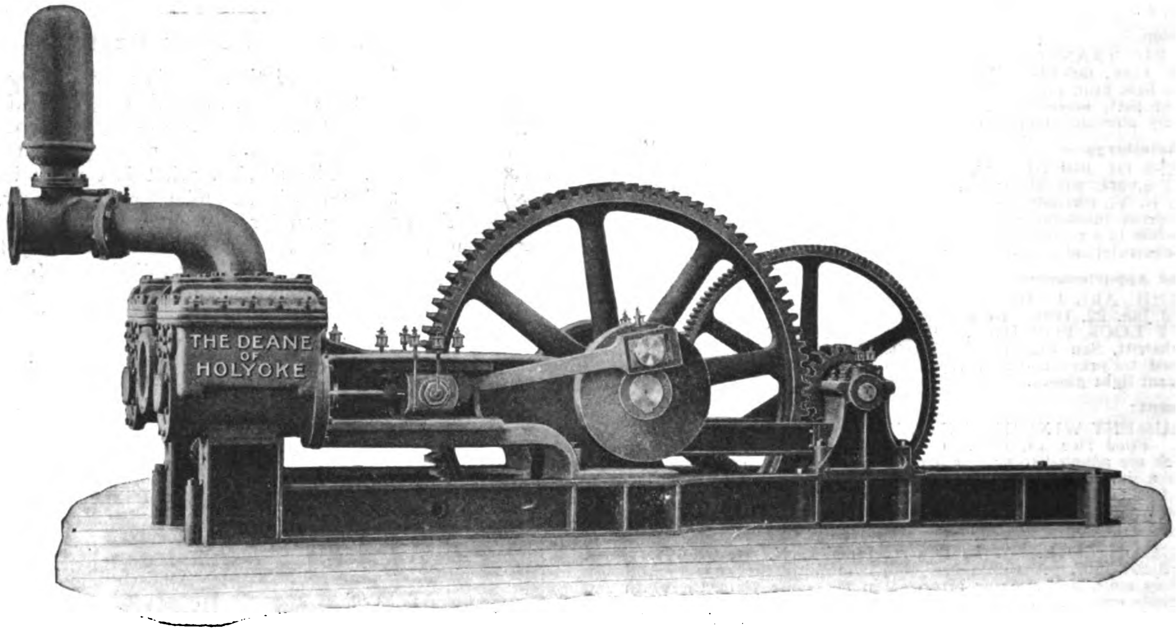


FIG. 1.—DEANE STEAM PUMP, CAPACITY 1,200 GALLONS PER MINUTE, AT HELENA MONT.

The operating of steam pumps in mines necessitates carrying the live steam from the boilers, which must needs be located at the top of the shaft, through long lengths of pipe to the pumps, which are located from 100 to 1,000 feet below. The large first cost of such an installation is apparent; it further means a loss of steam by condensation, and an equally as expensive means must be provided to care for the exhaust steam. The latter is not only a factor of much expense, but often fills the mine with a vapor, causing an intense heat, which is unbearable to those engaged in the work. This, of course, is obviated by the use of electric pumps, another advantage of which is the ease with which they may be moved in the shaft, depending upon the height of water. The machines shown are furnished with heavy iron bases, or bed plates, extending the entire length, which enables the apparatus to be raised or lowered at will without interfering with the alignment.

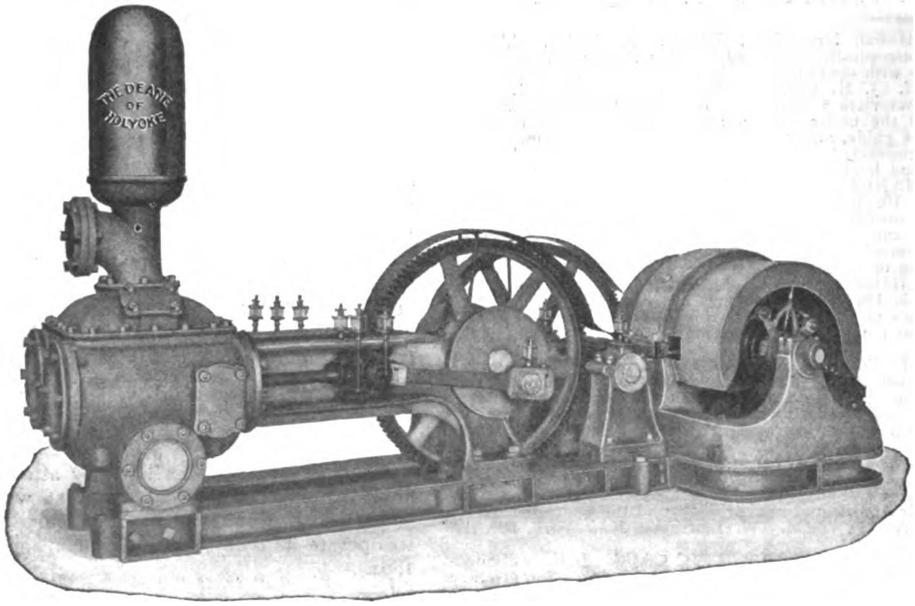


FIG. 2.—DEANE STEAM PUMP CONNECTED TO MOTOR; CAPACITY 400 GALLONS PER MINUTE, AT HELENA, MONT.

The Deane Steam Pump Company, of Holyoke, Mass., have been builders of mine pumping machinery for many years, and their line of patterns for steam and electric pumps is large.. In the accompanying illustrations are shown two Deane electric mine pumps recently put in operation at the United States Smelting Company's mine, near Helena, Mont. Fig. 1 shows a pump arranged for a motor and has a capacity of 1,200 gallons per minute. Fig. 2 is complete with motor and has a capacity of 400 gallons per minute.

Both of these are of the duplex pattern, embodying all modern features; the water ways are ample and furnished with means for inspection of interior parts; all bearings are lined with genuine babbitt and the gearing is of hard iron accurately cut to a true pitch; parts subjected to constant strain are cast from steel, and means for taking up wear are provided. Everything is of the strongest and best.

TRADE NOTES & NOVELTIES

General Electric Co.'s Supply Headquarters in Chicago.

IN facilitating its relations with that large class of its customers located in the Middle and Northwestern States and dealing directly with its Chicago sales office, the General Electric Company has found the large warehouse and repair shop which it has established in that city of the greatest value. The warehouse and repair shop occupy a commodious and well-lighted six-story and basement building, abutting on the main lines of three great railroads—the Chicago & North-Western, the Baltimore & Ohio and the Wisconsin Central. It is also on the Belt line, which connects with all the other railroads radiating from Chicago. From these, into a special spur by the side of the warehouse, the cars of any of the roads may be switched, and the warehouse has thus the great advantage of shipment and reception of goods in carload lots, to or from any point in the Union.

The top, or sixth floor, is devoted to the storage of unbroken packages of arc lamp globes, porcelain and glass insulators, insulator pins and cross-arms, armatures of the older types of machines, etc. On the fifth floor is stored a stock of incandescent lamps in original packages ready for immediate shipment, fan motors, arc lamp globes in broken lots, arc lamp carbons, etc. At the time of writing this the incandescent lamps of various candle powers, voltages, etc., in stock numbered roughly about 500,000, which number is kept constantly on hand by weekly shipments from the Edison Lamp Works, of Harrison, N. J.

FIG. 1.—CHICAGO STOREHOUSE AND REPAIR SHOP, GENERAL ELECTRIC COMPANY.

The fourth and third floors are laid out in floor bins and wall cupboards, the latter divided into pigeon holes of various sizes. Each bin and each pigeon hole has the catalogue number of the device or part it contains and so well is all arranged that a boy could fill from the bins and cupboards any order for supplies, large or small. On the fourth floor are the larger wiring supplies and parts, arc lamps—single and double carbon series and open and enclosed arcs for direct or alternating circuits; car resistances, and meters and type "H" transformers of all sizes, in the original factory boxes ready for re-shipment at the shortest notice. In the bins on the third floor are the smaller wiring supplies and parts. To attempt to enumerate all the devices kept in stock in this warehouse would be to transcribe the supply catalogues of the General Electric Company; suffice it to say, that no order, however large or insignificant, but can be filled from this stock.

The second floor contains the repair shop, fully equipped with lathes, planers, drill presses and shapers, all driven by electric motors. The front part of this room is given up to the armature rewinding department. On this floor is located also an elaborate meter, lamp and transformer testing department, as well as a dip room and polishing room for re-finishing arc lamp casings, etc. On the first floor are stored all the heavy machines—generators, motors and the larger sized transformers. This is also the shipping and receiving room for all the stock, and one corner is devoted to the office, while in the rear is a small carpenter shop, with planer and a circular saw driven by a 5 h. p. motor. An overhead track equipped with traveling chain hoists runs above this floor and out over both railroad tracks and the street and greatly facilitates the shipment or reception of the cases of supplies or apparatus. Along one side run a number of large bins, each labeled with the name of a railroad or express line. In these bins are placed the cases for shipment, so that they may be shipped out rapidly without confusion or mistake. By a special arrangement with the express companies, four shipments, the last at 6 p. m., are made daily. Thus express orders leave the warehouse the day they are received at the office.

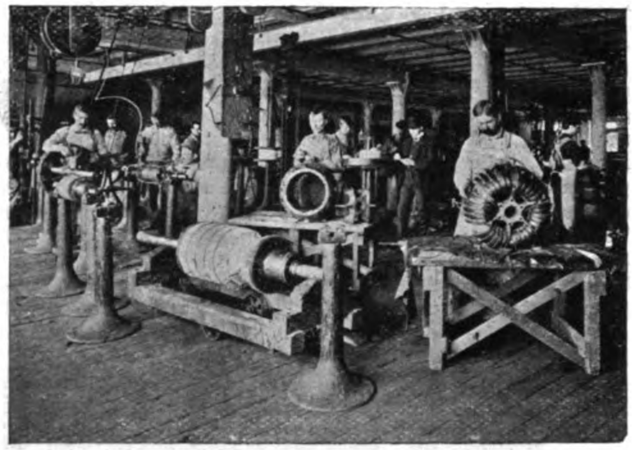


FIG. 2.—ARMATURE REWINDING DEPARTMENT.

The basement contains the power plant, consisting of two 80 h. p. boilers and two horizontal engines, one of 100 h. p., used for dynamo testing purposes, the other a 50 h. p. engine belted to a direct current machine, from which the lighting and power current used in the building is supplied, and to a 20 k. w. alternator, used for meter and other testing purposes. The basement also contains a boiler feed pump, a water heater, a large fire pump, four large steam-heated ovens for baking armatures and dynamo field coils, and a switchboard divided into three sections, equipped for testing high tension series arc machines, direct current low tension machines and alternating testing work. The load for the first consists of a bank of arc lamps, also in the basement; for the second, a large water rheostat under the

FIG. 3.—METER AND LAMP TESTING DEPARTMENT.

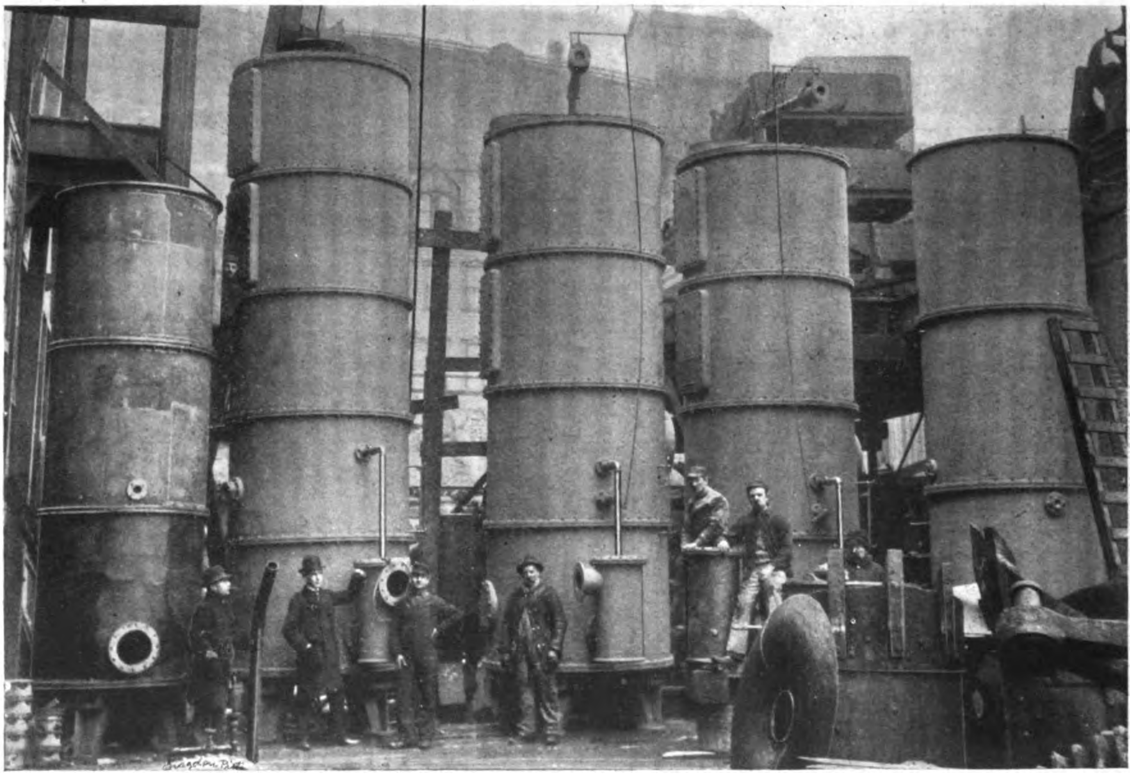
sidewalk, and for the alternating section a large bank of incandescent lamps on the second floor. Beneath the sidewalk is kept a large stock of insulating oil for transformers. The different floors are connected by a four-ton elevator.

The repair shop is in charge of Mr. L. G. Crawford. The warehouse was arranged by and is under the care of Mr. George M. Ellis.

Pittsburg Feed-Water Heaters and Purifiers.

THE attention of steam users is called to the claims made for the Pittsburg feed water heaters and purifiers, both of the open and closed types, and for which James Bonar & Co., Pittsburg, are general sales agents. The open heaters, as shown by accompanying illustrations, which are a lot recently manufactured for one of the Carnegie and Shenango Valley Steel Company's plants, are cylindrical in form, and are made in various sizes, these in the illustration being from 18 to 23 feet in height and from 5 to 6 feet in diameter, the largest being rated at 5,000 h. p.

These heaters are manufactured in sizes from 50 to 6,000 h. p., and there are now over 60,000 h. p. in use. The shells, as well as the interior mechanism, are nearly in all cases made from cast-iron, except where steel is preferred, it being considered that cast metal is less liable to corrosion from the action of acids than rolled steel or iron. The internal mechanism consists of a spraying device located at the top, a series of settling pans circular in form, but loosely attached to a central hollow shaft, and floats for operating the valves in the supply pipes. The cold water is admitted at the top, through a pipe, which enters at the centre of the head, and which branches near the head into a number of radiating brass pipes, which are perforated on the sides, with the outer end closed. By this means the water is distributed evenly in a spray over the whole surface of the upper pan, which is provided with perforations, through which the water flows in small streams to the pan below, then over the edges of the succeeding series of pans, until it reaches the bottom part of the heater. The exhaust steam is admitted by a pipe through the sides of the heater, below the pans and ascends along the outer edge of the pans and through the hollow shaft, which in turn is perforated between each series of pans, so that the steam passes over the surface of each pan, and rises along the outer edges to the discharge pipe at the top, imparting its heat to the finely sub-divided water in its passage. On account of rapid condensation and ample space there is no back pressure. The sediment is deposited in the pans and at the bottom of the heater. The pans are each independent of the other, and, being mounted loosely on the central shaft, can be readily turned and every part brought before a side door for cleaning or inspection. As a means of purification, there are placed in the base of the heater, just above the normal water level, two perforated blow-off pipes, bent in the form of a horseshoe, and so arranged that the oil or other impurities that may float on the surface are skimmed off and discharged. A sensitive float, consisting of a copper ball, is provided which operates a valve in the supply pipe at the top and thus regulates the supply of water. As a further precaution to prevent impurities from entering the boiler, the pump suction pipe is attached to the side of a small auxiliary cylinder, called the oil separator. This cylinder has a large water connection with the supply in the base of the shell, but below the surface of the water and above the bottom of the heater. This is much larger than the suction pipe, which enters the cylinder below the surface of the water, while a second pipe connects the top of the cylinder with steam space in the heater, so that should the water for any cause fall to a level with the suction pipe, it would draw steam instead of water, and so prevent its drawing in any floating oil that might possibly have gained entrance to the cylinder. The main shell and the auxiliary cylinder are each provided with a blow-off pipe at the bottom, by which means any sediment is readily removed. Large cleaning doors and manholes are also provided. A thermometer and water gauge complete the essential parts of the device.



PITTSBURG FEED WATER HEATERS AND PURIFIERS.

The manufacturing facilities controlled by this firm are ample and orders can be filled in from ten days to two weeks.

In the closed type of heaters the water passes in pipes and is heated by the surrounding steam. These are manufactured in various shapes, both with curved and straight pipes, opening into chambers. Heaters of either type are made in special form to suit peculiar locations or to meet the views of intending purchasers. All the heaters are built under the supervision of Mr. J. E. Schleiper, inventor and patentee.

POSTAL TELEGRAPH BOYS now wear blue uniforms instead of gray, the cloth resembling in color that used for the army.

New Enclosed Lamps of the Manhattan Co.

DURING the past four years the Manhattan General Construction Company have been gathering together all of the improvements possible on their old lamp, and have delayed until now changing even in the slightest detail the old structure, as it was so generally adopted by central stations that entire uniformity of parts was essential. While the Manhattan company still furnish their old types of lamps, they have brought out a line of new improved types, which are designed to burn in multiple on direct-current circuits of from 90 to 250 volts; in series on circuits of from 200 to 600 volts, and on alternating current circuits of any frequency from 90 to 130 volts.

While retaining all of the well-known and valuable features of the old lamp, they have combined many new and radical departures. The principal defects which experience showed to exist in the old lamps were:

First, length of 36 inches, which has been reduced to 29 inches.

FIG. 1.

FIG. 2.

FIG. 3.

Second, on the old lamp it was necessary in retrimming to remove entirely from the lamp the spider holding the pan, the inner bulb, the gas check plug, the carbon and the sheath, all of which either had to be held in the hand or laid down while replacing carbons and cleaning the bulb. In trimming, both hands had to be used, and when the lamp was hot this method became a hardship. To provide, however, for cases where stations preferred to obtain entire uniformity of all parts required to be handled by trimmers, it has been arranged so that the new lamp may be furnished to take the old style of trim or new style of trim may be furnished for old lamps now in service. The trim is removed in shipment.

Third—In the old lamp the outer globe is stationary and is a fixture on the body of the lamp. This saves handling, and many central stations claim that the saving thus made in breakage of outer globes nearly pays for renewal of inner bulbs, and this feature has been retained in the new lamp.

Fourth—In all other types of lamps the outer globe is lowered to give access to parts in trimming. In the new Manhattan lamp there has been introduced the novel feature of lowering the bulb down through the opening in the bottom of the outer globe on double telescoping rods, as shown in Fig. 3. The inner bulb and carbons are thus brought in full view below the lamp, and after retrimming the device on being raised automatically locks in position. To lower the trimming device it is only necessary to press the knob on the bottom of the lamp. The carbon sheath is removed as heretofore, but the current is fed to the upper carbon directly through the sheath in place of a separate brush box, as formerly. Contact between the sheath and the inner tube is made by means of metal balls contained in the sheath. Magnetism automatically attracts these balls against the sides of the inner tube and assures perfect contact.

Fifth—It is perhaps not sufficiently well understood that one of the secrets of the life of the carbon is largely dependent on the style of closure of the top of the inner bulb. The cap used in the new Manhattan lamp is provided with a gas chamber which materially lengthens the life. This cap is made under the patents of L. B. Marks and Moses S. Okun, and is said to cover every form of cap having a gas chamber and lateral movement.

Sixth—In the old Manhattan lamp one of its great disadvantages was that to adjust the current it was necessary to take out the pan and bulb, take off the globe and yoke, take the lamp down from its hanger, take off the top plate, undo the wire connections, remove the rheostat and take off the shell from above. In the new Manhattan lamp, the mechanism shell may be lowered while the lamp hangs in position, by removing the trim and the outer globe and giving the central cylinder a quarter turn, when the shell may be removed and the current adjustment of the lamp can be changed.

The adjustment of the rheostat for voltage may be made by loosening the set screws and lowering the split canopy at the top, as shown in Fig. 4 at letter A.

Seventh—While the great claim for Manhattan lamp has always been its simplicity, it will now be found that all the mechanism below the armature has been dispensed with and that the only moving part in the lamp is the armature, inside of which, however, is a ball clutch. The clutch of the old lamp consists of four rings passing through slots in the armature, and the whole lamp had to be taken down and apart to reach the clutch. For this four balls have been substituted, which ride between the inclined surface of the inside of the armature and openings in the central brass tube. The armature and the clutch may be removed from the lamp while it hangs in position by undoing one nut.

Eighth—In the old lamp the part requiring most frequent renewal and which was a general cause for repairs was the brush box through which the current was fed to the upper carbon This has been entirely eliminated from the new lamp.

Ninth—One of the sources of danger to short arc lamps has been that the arc is so close to the mechanism there is a likelihood of burning out the magnet. This has been provided against by the use of a ventilated magnet, and a current of air is constantly passing between the magnet and the central tube.

Tenth—The steady burning of the old type lamp depended absolutely upon the perfection of the air chamber, requiring great nicety of manufacture. It was impossible to make the lamps altogether interchangeable. In the new lamp there is no such chamber, and a loose fit is maintained between all of the parts. In addition to the air chamber in which the armature works in the old lamp, a further chamber was provided around the clutch, making it necessary to take the shell off in a most inconvenient manner; and great care had to be used in replacing the insulation at this point. This made the old lamp most difficult to assemble, but it has also been remedied in the new lamp.

Eleventh—In the old lamp proper assembling was the most important feature. Unless it was done with accuracy and the lamp was lined up exactly, it would not burn properly, and it was almost impossible for users of the lamp to take it apart and put together again without special tools. All of the parts were assembled with driving fits, whereas in the new lamp all of the parts are loose fits and may be removed with the fingers; and to entirely remove all of the parts of the lamp it is only necessary to remove two nuts.

In the old lamp, to take out the magnet, it is necessary to remove the globe and the lower frame, take the lamp down, take off hanger, nut, top plate, rheostat, outer shell, inner air chamber shell and brush box, then to remove four screws and insulating washer from casing holding outer globe, then remove clutch by removing two screws holding clutch pan to the armature, loosen set screw and take out the magnet frame plug (which was a driving fit into the magnet frame), remove armature from top, then take out magnet tube (which was also a driving fit into the magnet frame). This central tube, forming the air chamber of the lamp, was most liable to be damaged in removing and replacing, and if not returned perfectly true would cause the lamp to stick. The number of operations to assemble the lamp is therefore reduced from 20 to 6.

In the new lamp, to remove the magnet, the lamp may remain hanging in position (see Fig. 4), taking off globes and frame G, unscrewing cap F, when there may be taken out the armature E, then unscrewing the nut D, and the central tube C and the magnet B may be slipped out of the frame A, and every part of the lamp is separated. The lamp may be assembled by the reverse operations. In taking apart the lamp no insulation of any kind is disturbed.

By an improvement in the electrical and mechanical design of the magnet and armature, the new lamp will be found to burn within very narrow limits, and with great steadiness.

The rapid extension in this country and abroad of the use of circuits of from 220 to 600 volts has caused a large demand for lamps to burn in multiple on such circuits. The new type Manhattan lamp has been designed for such service, and the mechanism of the lamp is exactly the same as the lamp above described, and the same lamp can be transferred from a 110 to a 220-volt circuit by the substitution of another coil and rheostat and a change of the nut holding the armature.

The same standard new type Manhattan lamp is also arranged to burn two or more in series on circuits of from 200 to 600 volts by a change of the magnet coil. These lamps will be furnished with a special form of separate rheostat for each lamp, which can be cut in to take the place of a lamp when one lamp in the series is cut out, without disturbing the balance of the series.

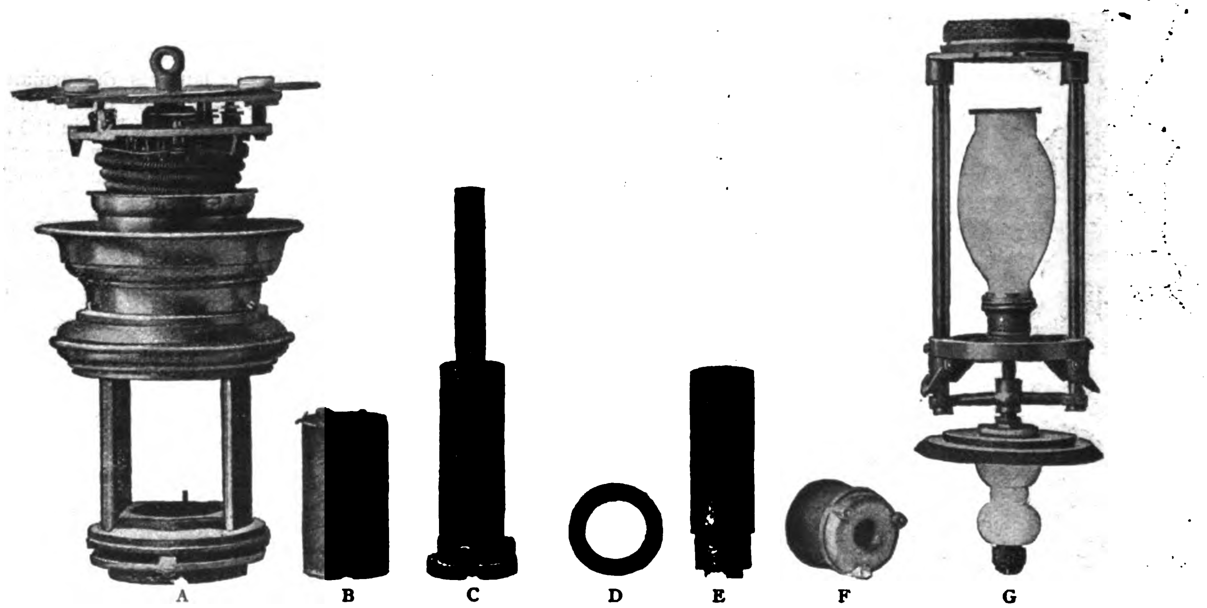

A B C D E F G

FIG. 4.

The new type Manhattan alternating enclosed arc lamp contains a different form of mechanism, as shown in the cut, but the trimming device, outer globe, gas check plug, carbon sheath and shell are the same as used on the direct-current lamp, and these parts of the two lamps are interchangeable.

The trim of the old type Manhattan lamp is also interchangeable with that of the new alternating lamp. While the mechanism is of a different type from that of the standard Manhattan direct-current lamp, the clutch is the same, and it will be noted that the entire mechanism consists of a magnet and core, stationary central tube containing the ball clutch and a dash pot. There have been eliminated all clockwork, toggle clutches, carbon rods, walking beams, racks, levers, etc. Access to the mechanism may be had while the lamp hangs in position by removing the globe and trim and giving the mechanism shell a quarter turn. The trimming device is removed in shipping.

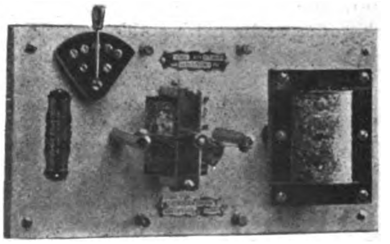
The Manhattan company state that they have been working on this lamp for nearly a year, and have put it through continuous commercial tests, and do not hesitate to state that the lamp will maintain the high reputation of the company. It is economical and reliable. It starts up quickly and without chattering, will run without variation of current and quietly from 100 to 130 volts where such variation is found to exist without readjustment. The lamp will burn 100 hours with one 9½x½ inch upper and one 6x½ inch lower carbon, and the unburned portion of the upper may be used as a lower for the next run. On circuits of 100 volts and 6 amperes the lamp consumes 450 watts. The length of the lamp is 29 inches.

The lamp may be adjusted by a simple change of connections on the top plate for circuits of from 7,200 to 17,000 alternations, and has a range of adjustment for voltage of from 90 to 130 volts. The outer globe is suspended on a white enameled ring about 7½ inches in diameter, and being directly over the arc acts as a reflector and materially increases the efficiency of the light. One special point in connection with this lamp is that the carbon sheath is removable from the lamp.

In designing these new types of Manhattan lamps, quality has been the chief consideration. Lamps could be built which would give almost the same apparent results at the start, but to secure ease of handling, perfection of operation and durability, there have been introduced materials, methods and styles of finish, which while increasing the cost of the lamp very materially, present a series of structures practically perfect in every detail. There is no reason why the only consideration in the purchase of arc lamps should be price, and it is to be hoped that central station people will appreciate the economy in well constructed lamps, as the slight addition of first cost is not to be compared with the cost of repairs and reliable service. The design of these lamps should certainly maintain the high reputation made by the Manhattan Co.

These lamps are manufactured under patents of the Marks Enclosed Arc Light Co., Moses S. Okun, Max Harris and others.

The Warner Battery Telephone Generator.

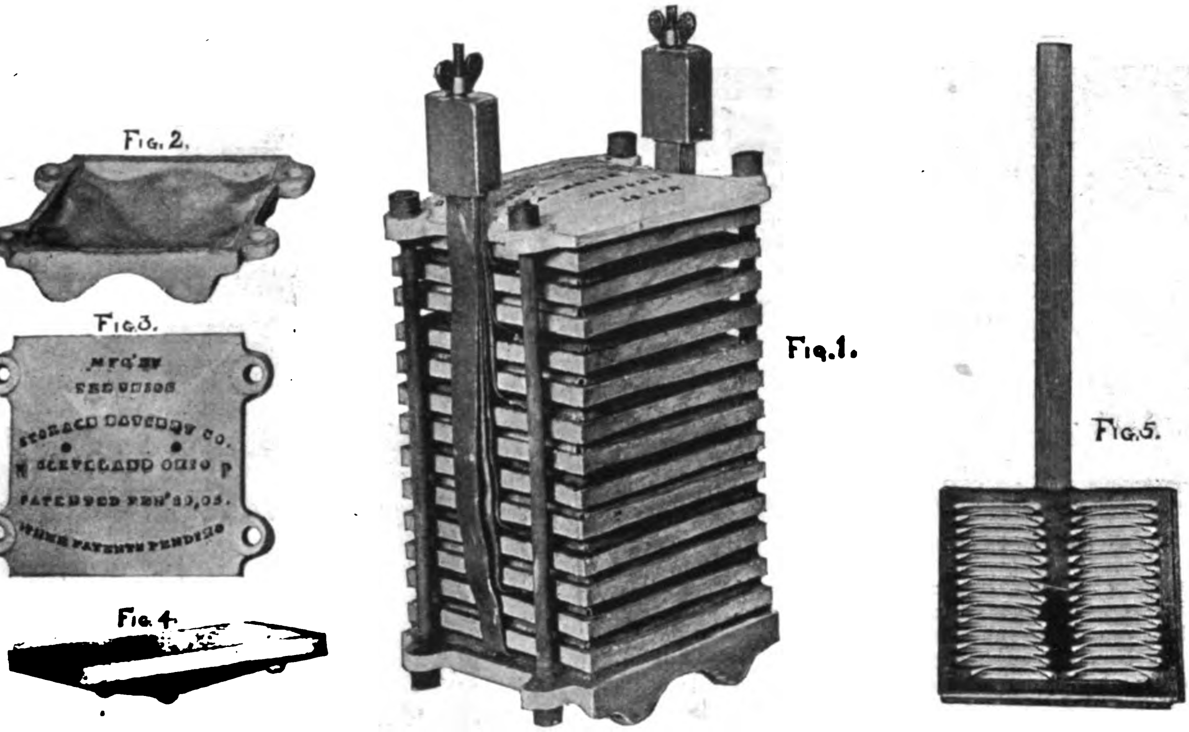


The cut shown herewith illustrates a new telephone generator, which has just been placed on the market by the W. F. Warner Co., of Muncie, Ind. It can be operated with batteries, either primary or storage, and can also be used in connection with electric lighting circuits. The power required to operate this machine is about three-tenths of an ampere at eight volts pressure and it is suitable for exchanges having less than 1,500 subscribers. It is a handsome machine, with marbelized slate base and nickel plated trimmings, has few wearing parts, consequently it is almost indestructible, and would be a valuable addition to country exchanges where electric light circuits are not accessible.

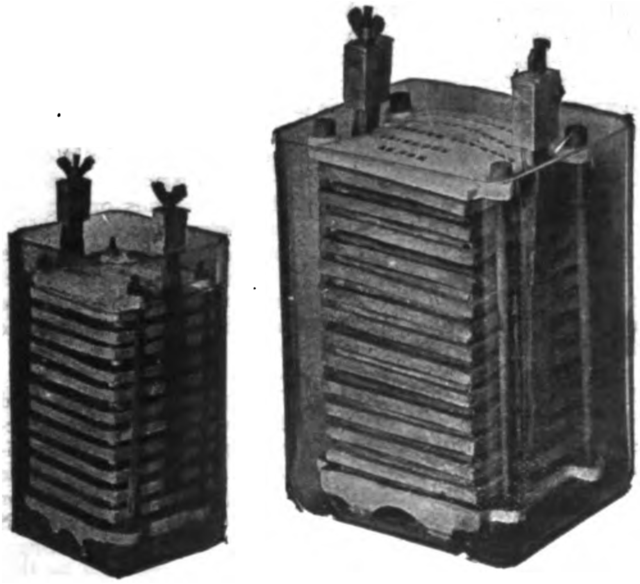
THE UNITED GAS IMPROVEMENT COMPANY, of Philadelphia, are installing at Yonkers, N. Y., a 50 h. p. Ball engine, built by the Ball Engine Company, Erie, Pa.

The Union Storage Battery Co. of Cleveland, O.

We illustrate and describe on this page a new type of storage battery which is being put upon the market by the Union Storage Battery Company, of Cleveland, with which Mr. F. C. Phillips, so well known in connection with the Elwell-Parker Electric Company, is prominently connected. It would seem that a large field of usefulness awaits such a type of cell as this. The battery or element, shown in Fig. 1, consists of a pile or stack of concave porous dishes in which are placed the lead conducting grid and the active material. The connections or conducting strips form alternate grids, constituting the positive terminal or pole of the element, being brought up on one side, and the remaining alternate strips on the other side, constituting the negative pole of the element. The stack of dishes, filled or charged in the above described manner, are held together by means of hard rubber rods between strong bottom and top pieces of glazed earthenware that are separately shown in Figs. 2 and 3. Fig. 4 shows the concave porous dish which carries the active material and the shutter-like grid shown in Fig. 5. The conducting grids are stamped out of pure homogeneous rolled lead. In the larger batteries, the terminals are arranged for suitable lead connections, to be made when the battery is set up in its permanent location. It will be readily seen that, since the active material and the conducting grids are securely held between the dishes, short circuiting is all but impossible. This latter is an exceedingly important and valuable feature of this battery. It will also be obvious that the element can be easily and with safety lifted as a whole out of its containing jar. The active material is placed in the porous dishes in the form of loose, dry powder, and is held or carried by the dish and not by the conducting grid; the conductor or grid resting mainly upon and in the active material. Owing to this fact, and to the fact that the plates are horizontal, the active material always tends to remain in contact with the conducting grids and does not fall away from such contact. This makes the battery, as it were, self-repairing, and besides eliminates any appreciable tendency of the plates to buckle or warp.



FIGS. 1, 2, 3, 4 AND 5.—DETAILS OF THE UNION STORAGE BATTERY.



FIGS. 6 AND 7.—COMPLETE CELLS OF THE UNION STORAGE BATTERY.

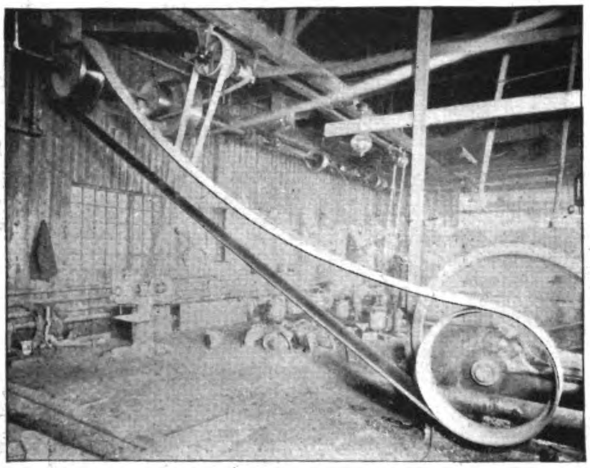
The weight of this battery can be reduced, if necessary, to a minimum for the reason, chiefly, that the lead grids can be made very light since they are of pure homogeneous and dense, rolled lead and perform the function of conducting current only; not supporting or carrying the active material or supporting their own weight. The smallest and the medium size of battery are shown in Figs. 6 and 7. It will be obvious that these cells can readily be connected up together, that they are easy to keep in repair and good condition and that they have a large capacity in proportion to their weight.

Dennison Tags Made by Electricity.

The celebrated "Dennison" tags are now made by Westinghouse electrical apparatus. The plant of the Dennison Mfg. Company, at South Framingham, Mass., represents ideal types of direct current power apparatus, well installed and operating in a manner that is entirely satisfactory to the owners. Electric apparatus of Westinghouse manufacture is used for the entire shops, the only steam plant being that which drives the generators. A complete system of arc and incandescent lighting is also in operation. The generating plant consists of one 200 kilowatt generator running at 100 r. p. m.; one 100 kilowatt generator of the same speed, and one 30 kilowatt machine running at 300 r. p. m. The machines are all of the 125 volt Westinghouse engine type. Seventeen slow speed Westinghouse multipolar motors of from 5 to 50 horse power are used for driving the shop machinery.

The "Cling-Surface" Belt Dressing.

THE illustration below shows the effect of the "Cling-surface" belt dressing on the bearing surface of a long belt in the shops of the Union Dry Dock Company. In the words of the foreman "For one year now, the belt has been treated with 'cling surface,' and although we have let it out, as shown in the illustration, it develops far more power than before, while the strain on bearings and belt is reduced to a minimum." Many favorable comments have been passed on this well known

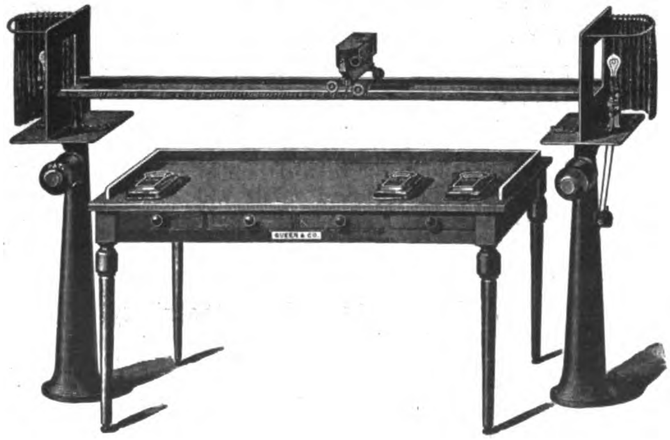


PLANT USING "CLING SURFACE" ON BELTS.

belt dressing in the past few years by prominent manufacturers and engineers, for it has many admirable qualities. It penetrates the leather, canvas or rope and produces a smooth clinging surface. It does not oxidize or evaporate like grease or oil, consequently what goes into the belt remains there. It is sold in 25, 50 and 100 packages or in barrels by the Cling-Surface Mfg. Co., 10 Court street, Buffalo, N. Y.

A New Queen Electric Light Photometer.

THE firm of Queen & Co. have placed on the market a new photometer, illustrated herewith. As will be noticed, it is a departure from the usual design. Cast-iron pedestals support the metal photometer bar and carry stages for the support of the lights, screens, etc. The rheostat shown on the left hand pedestal is for the control of the potential on the standard. It is about 800 or 1,000 steps and permits of perfect adjustment. A similar rheostat on the right regulates the current on the test lamp. The graduated bar is inclined at an angle of 45 degs., in



QUEEN & CO.'S CENTRAL STATION PHOTOMETER.

which position the graduations are lighted by the lamp under test.

The screen, which may be of either the Bunsen or Lummer-Brodhun type, is mounted on a truck and may be rolled along the bar wherever desired. A milled-head permits of close adjustment when balance is nearly attained. The instrument is complete in every respect, and the result of several years' experience with photometric apparatus. Those interested may obtain from the makers a circular more fully describing the photometer.

The Graves Arc Lamp.

THE Graves arc lamp, which is displayed prominently in our advertising pages of this issue on a colored sheet, is worthy of attention. The broad field in which these lamps have been used and thoroughly tested by many hands under the most

GRAVES ARC LAMP.

extreme range of conditions, under the widest climatic changes, and the attendant patient study to practical detail, have brought them where they stand to-day, a standard of excellence in their line, and have forced electrical engineers and experts to recognize them as such. The increased demand for the past seven years is unimpeachable evidence of this fact, and to keep pace with the times Mr. Graves has constantly added more capital and modern machinery, until now his plant is one of the most complete in the country.

The Graves arc lamp received highest honors at the World's Fair in 1893 "for good construction and satisfactory performance when in use," and there have been no pains or expense spared since to keep pace with the improvement of the times.

Their long-burning enclosed arc lamp, which was brought out about three years ago, has met with great favor, and improvements have been made since that time so that it stands at the front, and can be depended upon for satisfactory performance under the most exacting circumstances.

PROVIDENCE, R. I. The Westinghouse Electric and Manufacturing Company has recently completed a novel electric plant for the Fletcher Manufacturing Company, of Providence, R. I. This latter firm is over 100 years old. The original Fletcher manufactured shoe strings and sold them for wheelbarrows. The concern is now one of the most successful in Providence, employing about 600 hands, making shoe strings, lamp wicks, etc. Until recently, two engines were used by this plant, one on each side of the street. Desiring to shut down one of them it was found impossible to run a shaft under the street, but permission was secured to lay electric wires. The single engine will now operate the entire plant, by running a 150 kilowatt, 400 volt, two-phase Westinghouse generator, which transmits current across the street to a 200 horse power type "C" motor. The motor is left connected with the generator most of the time, thus enabling the two plants on the two sides of the street to start up together.

Improved Thompson Focusing Electric Lamps.

FIG. 5.

We illustrate and describe herewith the improved focusing arc lamp which has just been brought out by A. T. Thompson & Co., of Bromfield street, Boston, embodying a number of advances in this important class of apparatus. Fig. 1 shows the open reflector "Olivette" box for lighting large areas such as back drops, side or wing tables, tableaux and all close range work. It is provided with a 90° improved Thompson lamp, either hand feed or automatic, and will run on either the direct or the alternating current. The electrical lens box or chaser is shown in Fig. 2, which is made interchangeable for open reflector as in Fig. 1 or for stereop-

FIG. 1.—OPEN REFLECTORS FOR LIGHTING LARGE AREAS.

ticon attachment as in Fig. 3. The electric lamp is the 90° pattern, entirely enclosed within the lens box to prevent leakage

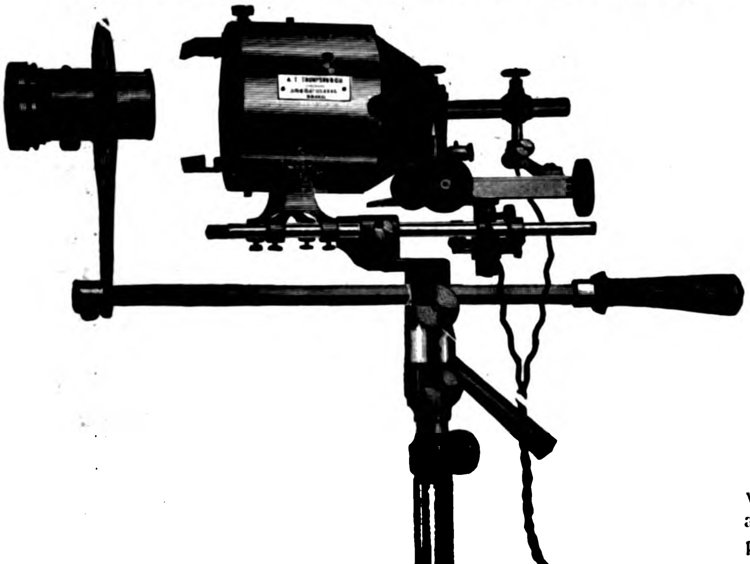


FIG. 3.—SHOWING OPTICAL PROJECTION ATTACHMENT.

of light. The lamp may be focused forward and backward for producing discs of light varying from a "spot light" to an area equal to the entire stage. The condensing lens is mounted specially to allow for expansion and contraction, and the risk of breakage is reduced to a minimum. The entire upper part of the apparatus is hung in a swivel socket, held by a large thumb screw, and may be inclined rapidly at any angle by the

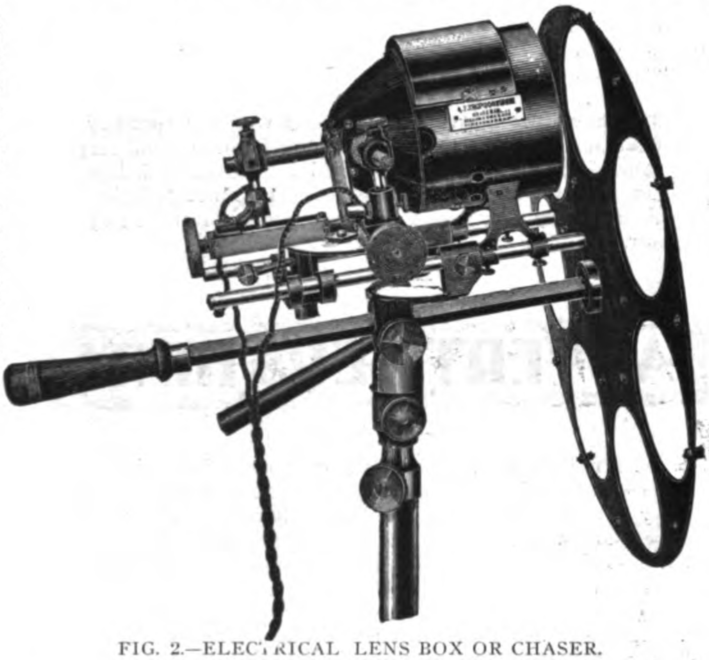


FIG. 2.—ELECTRICAL LENS BOX OR CHASER.

movement of the lever. A large wheel for seven colors is provided, as shown in the illustration, or a small wheel for four colors. The latter may be used to advantage for illuminating the serpentine dance by revolving rapidly.

Fig. 3 shows the optical projection attachment for producing moving water, rainbow, and all other similar effects, either at short range from the stage, or from the balcony; also for illustrating lectures, and in "between the acts" numbers. It may also be used for the exhibition of election returns, news items, etc. This apparatus is similar to the one shown in Fig. 2, to

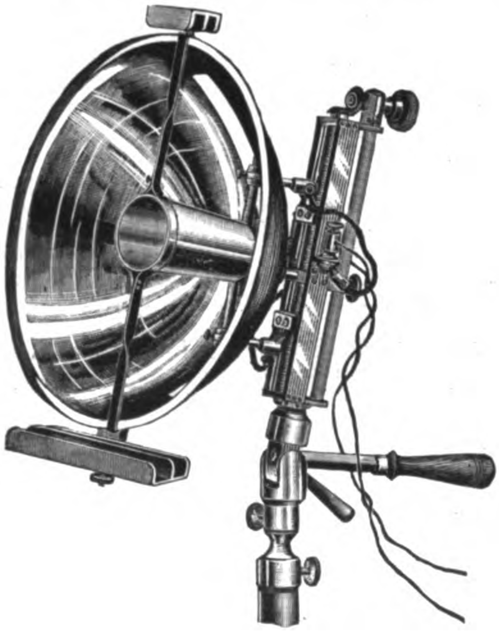


FIG. 4.—IMPROVED BALCONY FRONT LIGHT.

which has been added an extra plano-convex condensing lens and slide carrier (all in one), objective lens and support. These parts may be instantly removed. All parts shown in Figs. 1, 2 and 3 are interchangeable; hence with one piece of apparatus it is possible to produce all stage lighting effects which ordinarily require the use of three pieces of apparatus.

The improved balcony front light is shown in Fig. 4. This

lamp is provided with a corrugated glass reflector, and a collecting tube to prevent the spread of light directly from the arc, making it possible to focus the beam as with a calcium. The candle power may be anything desired from 2,000 to 10,000 and is regulated and controlled by an improved adjustable rheostat. The reflector is provided with grooves for holding colors. The stand adjustments are the same as supplied with the other Thompson stage lamps. This apparatus may be fitted with an automatic electric lamp which is desirable where lamps are to burn for any length of time without color changes.

Fig. 5 shows the horizontal feed lamp which is specially designed for use in connection with electric fountains and serpentine dances, the light being projected from a point below the stage or fountain through plate glass. The reflector being adjustable vertically, the spread of light may be controlled by the operator.

ADVERTISERS' HINTS

C. W. KENNEDY, 44 North Fourth street, Philadelphia, advertises electric vehicles containing the greatest capacity and efficiency with the least weight. In another place in this issue may be found a description of this type of carriage.

TWENTIETH CENTURY LAMP WORKS, 1031 Walnut street, Philadelphia, are introducing an incandescent lamp of very novel construction.

J. JONES & SON, 64 Cortlandt street, New York, advertise ceiling, wall and desk fans for alternating and direct current.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, are at all times prepared to supply tools for many purposes, including drills, reamers, taps, files, saws, wrenches, etc.

THE NOWOTNY ELECTRIC COMPANY, 208-212 Lawrence street, Cincinnati, O., call attention to their 150-hour arc lamp of the enclosed type. Their catalogue is interesting.

GEO. M. MAYER, 79 Fifth avenue, Chicago, Ill., advertises telephone materials of all kinds.

JAMES BONAR & CO., 121 Carnegie building, Pittsburg, the manufacturers of the Pittsburg feed water heaters, purifiers and receivers, mention the enormous sale recently made by them to the Carnegie Steel Company, amounting to 22,500 h. p.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., illustrate their direct coupled ventilating fans and also mention transformers, illuminated dial instruments, ceiling fan motors, single-phase power motors and direct current motors and generators.

THE BRUSH ELECTRIC COMPANY, Cleveland, O., present a revised list of the stations in which large Brush units have taken the place of smaller units. It aggregates 22,000 lights.

THE W. D. GRAVES ELECTRICAL AND MACHINE WORKS, Cleveland, O., refer to the points of merit their lamp embodies and make a guarantee with specific features on all lamps they sell, so positive are they that their claims are correct.

A. L. BOGART COMPANY, 123 Liberty street, offer dynamo electric torches at reduced prices.

THE GARVIN MACHINE COMPANY, New York City, advertise drill presses in a large variety of styles and sizes.

THE OTTO GAS ENGINE WORKS, INC., of Philadelphia, have removed their Chicago office to 360 Dearborn street.

THE WOLVERTON-ELLIOTT ELECTRIC COMPANY, 442 Niagara street, Buffalo, N. Y., are always ready to undertake general electrical repairs. They have been in this particular line of business seventeen years, and there ought not to be much they do not understand.

THE ELECTRIC GAS LIGHTING COMPANY, 192 Devonshire street, Boston, Mass., advertise the No. 2 Samson battery "shipped set up."

THE W. F. WARNER COMPANY, Muncie, Ind., are bringing out a device for generating current for telephones. It is operated by storage batteries, primary batteries or any source of electric current. They will be pleased to furnish details.

THE CROFTON STORAGE BATTERY COMPANY, 327 Dearborn street, Chicago, request an opportunity to quote low prices on their batteries. Some of the characteristics are noted.

WESTERN NOTES

THE CENTRAL ELECTRIC COMPANY, Chicago, report a brisk trade in Westinghouse alternating current fan motors, one reason for this being the fact that they are carrying large quantities in Chicago stock. Hot orders in hot weather can be filled immediately.

CHAS. S. WEISSE & CO., Sheboygan Falls, Wis., are installing an electric plant for power and lighting purposes in their works at that place. A 110 h. p. Ball engine, built by the Ball Engine Company, Erie, Pa., will furnish the necessary power. An electric light and power plant is being installed in the works of the Jackson Corset Company, Jackson, Mich. A 60 h. p. Ball engine, built by the Ball Engine Company, will furnish the power.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. JUNE 23, 1898. No. 529.

Westinghouse Crane and Elevator Motors.

THE Westinghouse Electric and Manufacturing Company has made a special feature of motors for crane and elevator service. The advantages to be gained by the use of electrical machinery in this field can scarcely be overestimated. While the great economy of electrical methods is strongly in their favor, often, for the sake of cleanliness, ease of operation, and adaptability to various kinds of service, the electric system is adopted when economy is quite a secondary factor.

The saving in a power crane over one operated by hand is undisputed. It is gradually being conceded that the electric crane is as far in advance of the steam crane as the latter was superior to the old hand type. Large saving in cost of operation has been reported from many quarters since the introduction of electric power. In one instance this was so great that an investment of several thousand dollars in two large electrically operated cranes paid for itself in eighteen months from the time of installation. Messrs. Wm. Sellers & Co. report another case where the saving in labor by introducing a ten-ton traveling crane, electrically driven, amounted to upward of $100 per day.

The above firm, in its catalogue on cranes, makes the following statement: "The electric motor furnishes the most convenient means yet devised of communicating power from a stationary source to the operating mechanism of a traveling crane."

The Case Mfg. Co., in its handbook on hoisting appliances, says: "It is no exaggeration to say that during the past ten years the development and subsequent introduction of electrical machinery in connection with almost every line of manufacturing industry has done more to reduce the cost of production than any other agency."

In no line has this been more conspicuous than in the operation of machinery for handling the product of our large mills, factories and railway shops. Prominent among such machinery stands the three-motor overhead traveling crane. Without its efficiency the mammoth proportions of our iron and steel foundries and kindred plants would be impossible. So generally is this recognized that a foundry not provided with overhead traveling cranes electrically equipped is now regarded as antiquated, even if built within the past four years. Everything in the way of improvements in this valuable device can not fail to be of interest to all those requiring such machinery.

The location of the motors is left to the builders of the crane. In most cases the bridge propelling motor is located on the side of the bridge directly over the observer's stand. This is most favorable to the operator. For foundries, this situation is especially favorable, as it exposes the motor to the least heat from the foundry floor and it is in most cases so arranged that when thus placed the motor in whole or in part can be removed without displacing any other part of the machinery. Each motor is especially prepared for crane service. Ample margin should be allowed for capacity.

The principal objections to the use of motors for this purpose in the past have been on account of mechanical difficulties with regard to speed, starting, and the harmful effects of dust and dirt. These difficulties have been met and overcome by both the Westinghouse alternating and direct current motors, which have been in successful operation under the most exacting service for the past three years. These motors were the first practical machines of their kind. The direct current dust proof motor is designed on the same lines as the Westinghouse multipolar generators and motors. It is planned especially for crane and elevator service, and every detail has been worked out with that end in view.

The dust proof motor has the same type of armature and poles as the ordinary multipolar machines, but has a circular frame and end plates, thus completely enclosing and protecting the mechanism. The plates are fastened by four bolts. A view of the motor and parts is shown in Fig. 1. The motor is light in weight and compact and simple in construction, without having undergone any sacrifice in durability or strength. It is absolutely dust proof.

One of these machines was supplied by the Westinghouse Company for the U. S. S. "Indiana." It is used for the ammunition hoist on the vessel, and has fully met the severe requirements imposed upon it. This motor was of course required to be entirely spark proof and dust proof. It runs in either direction without changing the position of the brushes.

The Westinghouse alternating current motor has proved its utiltiy in many striking applications. In no field has it been more successful than in that of crane and elevator service. Many large plants are equipped entirely with this system of distribution, and the compactness and efficiency of the apparatus has in every case been manifest. A prominent example of this is to be found in the new shops of the Boston & Maine R. R., at Concord. The two-phase alternating system is here used. The electric crane circuits are wired for a current of 200 amperes. The transfer table requires 60 amperes. All circuits are at a potential of 440 volts, excepting those supplying the lamps at the shops and at the Y. M. C. A. Building, half a mile from the shops, which are 104 volt.

The motors are of the Tesla polyphase induction type, built by the Westinghouse Company, running on 7,200 alternations. The uses to which the motors are put are as follows: To run shafting for the locomotive shop, for the bending rolls in the boiler shop, for driving the fans in the forge room, and other blacksmithing machinery, and in connection with the cranes and transfer tables.

The Westinghouse alternating current motor is especially adapted to this kind of work, and the type used in this installation is worthy of study. The motor consists essentially of two elements, viz., a stationary part permanently connected to the main circuits, and a rotating part having no connection with any other portion, and absolutely no contacts or adjustments. There is no sliding or working friction except that of the shaft in the journals. These are the only parts that are subject to wear. On account of the light weight of the rotating part, this friction is very slight. Ample self-oiling bearings provide for liberal lubrication. The motor is designed to operate with maximum effectiveness and minimum attention.

The hollow cylindrical frame of cast-iron, in which the primary is mounted, forms a base for the machine and also supports the two end brackets carrying the self-oiling bearings. Perforated iron plates fitted into these brackets protect the rotating element and permit excellent ventilation. They may be replaced by solid plates when it is desired to make these motors absolutely dust proof. It will be noted that the housing completely encloses the primary and secondary elements and protects them from damage.

The primary element consists of a hollow cylinder built up of sheet iron rings laminated and slotted on the inside to receive the conductors. These rings are rigidly supported by the cast-iron housing which encloses the primary. The conductors are machine wound coils which are thoroughly insulated before being placed on the core. The terminal blocks which are located at the top of the machine are connected to the primary winding by leads which pass through the housing.

The design and principles governing the construction of this motor (known as the Westinghouse Type C) are favorable to maintaining a high and almost constant efficiency from full load to one-half load. By maintaining a constant efficiency, it is possible to secure an all day or average efficiency very much above that heretofore obtainable, with either direct or alternating current motors. The variation in speed between no load and full load is small, being less than that found in direct current motor practice, as determined by exhaustive tests.

A polyphase induction motor may be started by connecting it directly to the circuit by means of an ordinary switch. Small motors are so started in practice. The larger motors are started on a reduced voltage, the full e. m. f. of the circuit not being applied until the motors have reached a considerable speed. The fact that in a four-wire two-phase circuit different e. m. fs. exist between different pairs of wires, affords an easy way of obtaining

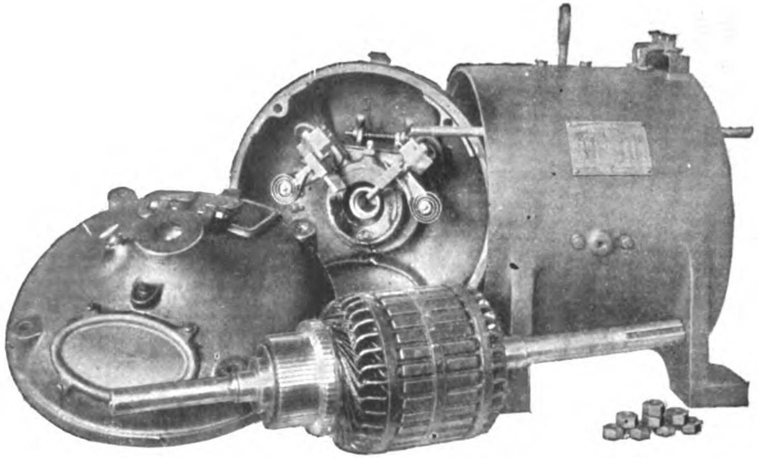


FIG. 1.—WESTINGHOUSE DUST-PROOF MOTOR. PARTS EXPOSED.

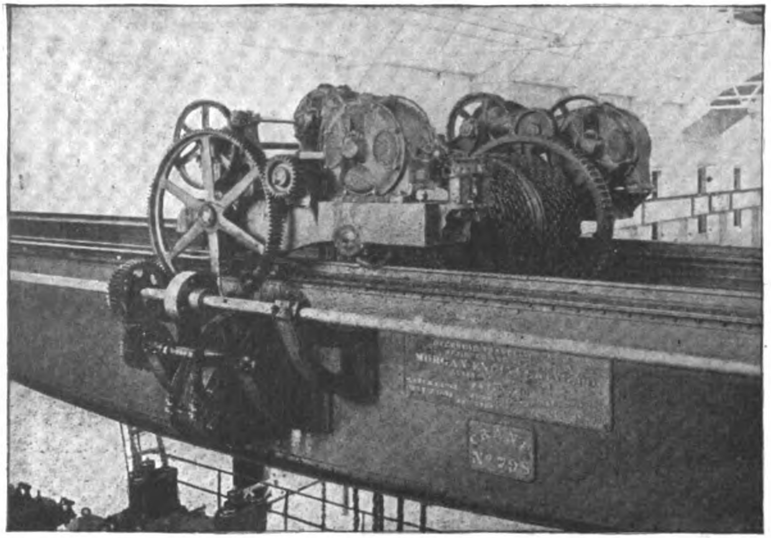


FIG. 3.—WESTINGHOUSE ELECTRIC CRANE IN OPERATION.

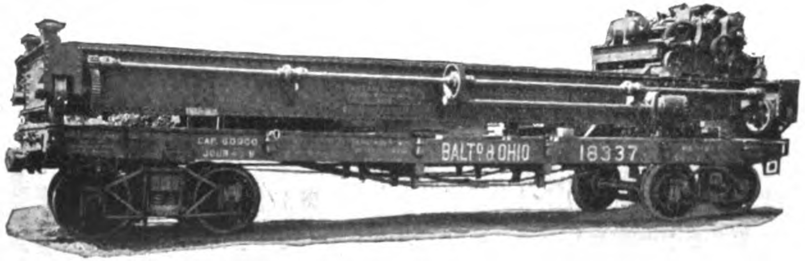


FIG. 4.—SHIPMENT OF WESTINGHOUSE CRANE MOTORS.

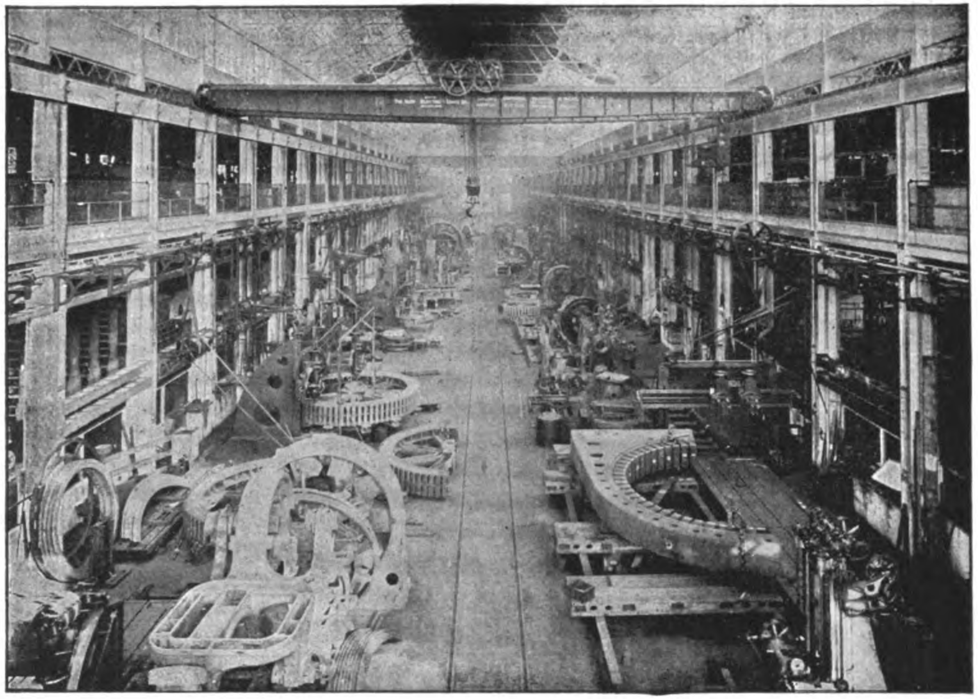


FIG. 2.—30-TON ELECTRIC CRANE AT THE WESTINGHOUSE WORKS, PITTSBURG.

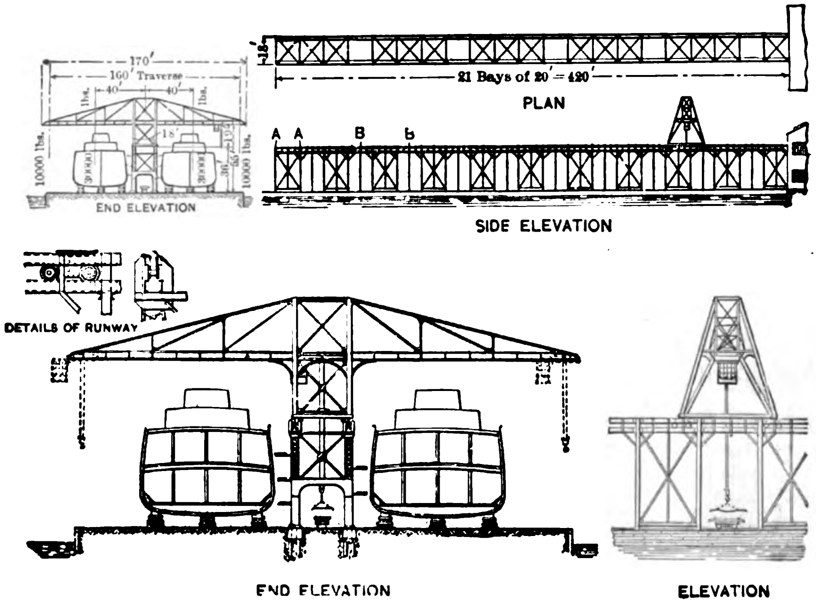


FIG. 5.—DETAILS OF CRANE CONSTRUCTION.

the necessary reduction in voltage. For some classes of two-phase and for three-phase service the reduction of voltage is effected by a device called an auto-converter. This device is entirely separate from the motor itself. It is possible, by the use of the auto-starting device, to adjust a motor after installation to have any desired starting torque within very wide limits. Thus a motor operating machinery having great inertia may be made to give a correspondingly strong starting torque, while one driving a very light device may be adjusted for extremely small starting torque, with a corresponding reduction in starting current.

The crane motors are provided with a regulator, by which the pressure is varied. The motor receives from the regulator a pressure varying from a small amount up to the maximum for which the motor is adapted. This variation gives a starting torque which is about four times the torque which the motor can develop at high speed continuously. The motor has a maximum speed which it does not exceed, even though the full pressure be applied with no load. The regulator consists of a special form of transformer, by which the voltage is efficiently reduced. A number of terminals are brought out from the transformers which are carried to the regulator so that the pressure from the various contacts can be successfully applied. The crane motors are exactly similar in constructi n, operation and simplicity, to the constant speed motors.

Another example of heavy work with crane machinery is at the works of the Westinghouse Machine Company, East Pittsburg, Pa. A forty-tone crane is here operated by two 20 horse power motors (alternating current) for the main hoist, one 10 horse power for the auxiliary hoist, two 5 horse power for the trolley travel, and one 20 horse power for the bridge travel.

Fig. 2 represents the main aisle at the Pittsburg works of the Westinghouse Electric and Manufacturing Co. This immense area, 750 feet long and 70 feet wide, is spanned by three 30-ton cranes, operated by 140 horse power of electric motors, each crane being manipulated by one man.

Fig. 3 shows a Westinghouse electric crane in operation. Fig. 4 shows a pair of alternating current motors on an electric crane ready for shipment. The details of construction in a crane service of this kind are shown in Fig. 5.

The motors are easily connected to types of cranes now standard, and offer the cheapest, safest and cleanest method of operation. The question is no longer, "What can be done?" The intending user has but to ask, "What has been done?" to learn of the enormous extension of the applications of electric power.

MUNICIPAL AFFAIRS

Public Lighting in Relation to Public Ownership and Operation.[1]

BY ALEX. DOW.

THIS paper is written to set before the association a proposed policy. It is not a new policy in its parts, neither is it an untried policy. It is applicable immediately to public lighting; that is to say, to the lighting of streets and public places under contract with, or on account of a municipality. Ultimately its application may be more extensive.

It is the belief of many members that the National Electric Light Association should formulate and publish a well-considered method of dealing with this business. While local conditions differ, there is no local difference in the principles which should govern electric lighting companies in their dealings with municipalities and municipalities in their dealings with electric lighting companies. An authoritative statement of these principles is needed. A statement by the association may be accepted in the first place only by the electric lighting companies, but if the principles so stated are intrinsically correct, their acceptance by the municipalities must follow. No city government will persist in a course that is plainly inequitable. City governments have in certain cases acted inequitably in the matter of public lighting, but their action has not been plainly inequitable. In such cases principles have been obscured by details or by personalities or have been but distinctly understood by the parties on both sides of the case. The public does not seek to be served at the expense of the individual. Public opinion may at times be biased, but it intends and endeavors to be just. And under our scheme of government public opinion is the final authority; and an appeal to public opinion is the ultimate means of redress for any grievance.

The advocates of municipal ownership have long recognized the value of public opinion and have presented their case both to the people of the country at large and to the citizens of selected municipalities through magazine articles, newspaper discussions, and addresses to public gatherings. Some of our members have met these arguments in kind and have confuted extravagant statements by the presentation of facts. But the man who is plainly arguing in his own interest is handicapped in a debate before a non-judicial tribunal as against those who claim to be disinterested. And it is not to be denied that the arguments which have had most influence on public opinion in this matter are those of theorists who certainly believe that they are doing the world a service, who are usually misinformed, always impracticable, but thoroughly in earnest.

A declaration of principles by this association and the recommendation to its members of a policy based on those principles would have greater weight with the public than the statements of individual companies, and would be accepted as authoritative over a wider area. But even if not accepted by the public its immediate acceptance by our own members will be useful. That each member must act for himself is a consequence of the conditions of our business, but that all should act on similar lines is possible and is desirable. Each of us looks to other cities than his own for light on problems which are new to him. Each of us, by a successful solution of any problems, benefits the industry at large, and, on the other hand, he who fails to appreciate and to properly deal with such a problem as this, injures, by his failure, not only himself, but all of us. Therefore it is well that we should agree on general principles and that we should advise with one another on special cases.

Let me make this general statement more specific. The member of this association who, by good service, by close figuring of expenses and of profits, and by clear statements and logical arguments, convinces the authorities of his own city that it is to their interest to leave their public lighting in his care, has done all of us a service. The member who, on the other hand, fails to recognize the drift of opinion among his fellow citizens, who tries to convince them that unsteady and uncertain lights are worth a high price, who depends for the retention of his city lighting contract on an appeal to the technicalities of his State law, or to the pockets of the venal members of his local Board of Aldermen, and who thereby brings about the erection of a municipally-owned electric lighting plant and the publication of the bare running costs of that plant in parallel columns to the prices which he wished to charge—the member who does these things which he ought not to do, and leaves undone those other things which he ought to have done, is a detriment to the industry throughout the entire Union.

I have indicated why I believe a declaration of principles and of policy is desirable. The principles to be declared will need little discussion, but the policy which to me appears best, may, when examined by others, appear to require amendment, or even radical change. It is offered to you for consideration in the belief that it is logical and that it is practical; but as a proposition for discussion and amendment, rather than as a perfected plan.

A CHAPTER OF ELECTRIC LIGHT HISTORY.

In the history of street lighting by electricity no chapter contains more profitable matter for study or for illustration of general principles than that which contains the record of the city of Detroit. That city was one of the first to use electric lights on its streets. It began in 1883 with 22 arcs, and in 1884 abandoned all other street lights. This street lighting business was believed by those who first engaged in it to be a monopoly secured by patent rights; they found their mistake after much money had been invested under that belief; competition ensued; then consolidation, and finally municipalization of the service. I shall find it convenient to refer to Detroit for more than one modern instance.

In February, 1896, the city of Detroit owned 1,500 arc lamps and was operating 1,492 of these in the work of street lighting. In the same month the successor of the Brush Electric Light

[1] Read before the Nat. Elec. Light Ass'n, Chicago, June, 1898.

Company, which installed the original 22 lamps in 1883, and which, until 1890, lighted the streets under contract, owned 1,049 arc lamps, and used in private lighting 433 of that number. Another company, organized in 1890 to compete with the Brush Electric Light Company, owned 1,330 arc lamps and was using in private lighting 38 of these. In each case there accompanied the arc lamps a sufficient number of dynamos, engines, boilers, etc., and a building fully equipped for the operation of the number of lamps stated. At the same time the city had in use 134 towers, which has been formerly owned by the Brush company, and the other company was in the act of taking down and removing from the streets 104 similar towers, which had formed a duplicate of the Brush company's equipment. The necessary lines to connect lamps distributed over a large city had been owned by all three. The city had in use 329 miles of overhead wires, connecting to its 1,492 lamps. Neither of the companies had owned such a great mileage of line, but one had taken down lines and poles which had supplied 719 lamps, and the other was in the act of removing lines and poles which had connected in 1,279 lamps.

Some of the Brush company's street lighting equipment had been during the preceding five years diverted to the supply of commercial lights. Nevertheless, two-thirds of that equipment is to the present day a useless asset. Lamps which were bought at $40 have proved impossible of sale at one-tenth of the price. Dynamos which cost $2,400 cannot be sold to-day for $240. Lines taken down returned only a small percentage of their cost to the treasury. The towers which this company sold to the city did not bring their original price—that goes without saying—but they brought a fair price.

The loss of the second company was greater. Changes in the business had made their street lighting arc lamps unavailable for commercial use, or almost entirely so. Similar changes had made their dynamos a slow asset. The engines were partially diverted into commercial service and the boilers entirely so. The wire taken down was not of a size that would fit in to their commercial lighting system and the poles hardly paid for the labor required for their removal. The 104 towers—one of the heaviest of all the original expenses—had to be sold as scrap iron.

A DESTRUCTION OF VALUES.

It is clear that a loss to some person or persons was involved in conditions which reduced machinery and lines capable of supplying over 2,000 arc lamps to approximately their junk value. Leaving out all questions as to personal fault—neither affirming nor denying that the loss fell upon those for whose economic blunders it was the inevitable punishment—it is certain that there was a loss to the community at large; that property which might have been and which had been capable of doing good service to the public, was as surely destroyed as if it had been swept out of existence in a great fire.

It may be asked on whom did the loss fall? In social economy the loss of one is the loss of all, but to our customary modes of thought there appears a difference between losses borne by ourselves immediately and those which are apparently borne by other people. In this case the greater part of the loss was borne by business men of the city of Detroit. It was a reduction of the available capital of men engaged in productive industry in the city. This reduction—this absolute loss—after correcting for inflated values which should have been written off long before the period of liquidation; after correcting for securities issued for cash at less than their face value, or for considerations which were valued at more than their true worth, was not much less than $400,000.

I do not ask you to sympathize with the immediate losers, but I ask you to remember as my argument proceeds that this loss came about in consequence of business methods and of social tendencies which are in active operation to-day in nearly every town represented in this association. And I submit as a principle not admitting of dispute, that the duplication of an effective equipment for public lighting is an economic error, entailing loss of available capital to the extent of the duplication.

IMPROPER COMPETITION.

The first error in Detroit was the offer of the city of competition for the public lighting contract. The men who made the offer knew perfectly that their success would mean a heavy loss to the original contractors, but they were willing to make a profit through other people's losses. In this they disregarded a principle much older than the electric lighting business—that which calls on us to do to others as we would that others should do to us. Some of these men doubtless thought that they were doing the city a service by providing competition, but the managers of the manufacturing concern which was the majority stockholder and chief promoter in the new organization had no such excuse. Their object was to sell machinery. I do not ask you to condemn these people now. They have reaped as they sowed, and the exploitation of competing lighting companies by manufacturing concerns is a thing of the past, although its consequences in the shape of inflated capital are likely to be a burden for years to come.

I submit as a direct application of the principle last stated, that competition for public lighting contracts, for the execution of which there is already an effective equipment in existence, is not legitimate business. The corollary of this statement is that the price at which public lighting is to be performed must be determined by some acceptable means other than competitive bidding. In this there is a departure from the established method of municipalities, which now depend on competition for the setting of prices on all public services performed by contract.

WANTED: A SUBSTITUTE FOR COMPETITION.

In the absence of some other acceptable means of setting a proper price for public lighting by contract, public opinion will not tolerate the suppression of competition. A reference to Detroit illustrates this very well. When the second company had, by making a lower price and by meeting the demand of the public for the undergrounding of wires in the business district, secured a three-year contract for public lighting, its managers found themselves in a precarious position. It was apparent that at the term of the contract they would again have to reduce prices to meet the competition of the original contractor, who could not afford to have his plant standing idle. It was also immediately apparent that the idle plant would be, as far as possible, diverted into private lighting work and would there also tend to reduce prices and to divide the available business. Legal questions as to patent rights added to the difficulty of the situation. An attempt to combine the two interests was plainly necessary, and it was made; but the inevitable personal soreness prevented a combination until the new company had completely duplicated the equipment of the old one.

Of course, the public became advised of the cessation of competition, and the advocates of municipal ownership made the most of the facts and added much fiction. Long before the contract had expired it was plain to any careful observer that it could not be renewed at anything like the former figure, and that the tendency of public opinion was strongly to municipal ownership. It was a period of "reform"—I use the word in its political sense—one of those periods when the taxpayers, usually content to be bossed unquestioningly by the practical politicians, insist on calling the particular bosses of the hour to an accounting and expect to find that they are rascals. And as the public's way of having an accounting is to discharge its servant first and take up the reckoning afterward, the public servants of such periods are quick to fall in with the drift of public opinion in order to show that they either do not deserve discharge or are fully justifying their appointment to their new situations. Politicians are wise at such times; lighting companies sometimes are very foolish.

So the cry went up that there was no such thing as competition in the lighting business; that the men engaged in that business all intended to rob the public, and that if they appeared at times to compete with one another, it was only a temporary falling out among rogues. And the public being told on the one hand that all existing lighting companies were composed of rascals, and on the other that all municipally owned plants were successes, made up its mind that its only salvation lay in municipal ownership.

You can see, and any careful student can see, that the suppression of competition was inevitable, because its continuation meant a cumulative loss to those engaged in it. Possibly the public might have been made to see this, although the time to have begun work on the public was before the first loss due to competition had been incurred. But to merely prove that competition was impossible would not have been enough. It must further be proved that competition was unnecessary, and the only way to do that was to offer good service at an acceptable price. Under the circumstances the price might have to be very low indeed, for the belief was abroad that the business was

enormously profitable at the established rates. The figures sent forth by certain municipal plants were quoted as warranting this belief, but these could have been contradicted. It was possible to send to Bay City and to Topeka a competent engineer—say one of the professors of the University of Michigan—whose dictum would be accepted by the newspapers and their readers; and so to obtain the true figures. It was possible to answer in a similar manner the argument based on the competing bid at the last letting of the contract. That argument was that any business which justified the erection of a complete manufacturing plant on the security of a three-year contract must be exceedingly profitable. The contract price was a good one, but it would not pay for the plant in three years, as the public of Detroit thought it would. A showing of the whole truth as to costs, certified by a recognized authority, and followed by a bid carrying a minimum profit, might have been accepted by the public as a substitute for competition.

A COLLISION WITH PUBLIC OPINION.

And here was made the second great error of the electric light companies. Their managers seem to have been the only people who did not see what was coming. They failed to keep in touch with their public. The public was absorbing all the fool figures that the wildest theorists could furnish, but never a figure deserving credence was offered in contradiction. The public was damning the poor quality of the lights then furnished and was told that it did not know a good light when it saw it. The public was determined to have much cheaper lighting, yet when bids were asked for they were almost as far above a possible figure as the costs published by the theorists were below it. The only hope for the contractors was to secure the support of the more conservative elements by offering good light at a minimum rate. On the failure to do this, and do it quickly and gracefully, municipal ownership was as certain as the coming of summer.

Some effort was made by the companies in the Legislature of the State and in the City Council to protect their interests, but these bodies, especially in a reform year, cannot be expected to go counter to a strong public sentiment. In this they are wise in their generation.

Would the public of Detroit, after the agitation for municipal ownership had become general, have approved of award of a contract at a low price, or would it have insisted on municipal ownership as a matter of principle?

An answer to this is merely an expression of opinion, but I believe that had a low price been offered the agitation for municipal ownership would have been suspended and that the companies might have secured terms more to their interest than was the action actually taken. There were many people in Detroit who did not wish to see the experiment of municipal ownership tried, except as a last resort. There were a few people who believed in municipal ownership as a matter of principle. There were doubtless also a few who expected to reap a personal benefit from the establishment of the city plant. Nevertheless the great majority of the citizens sought only to reduce the expense and to improve the quality of the public lighting, and cared nothing for city ownership, except as a means of reaching a desired end.

In other lake cities where the agitation was fully as strong, concessions on the part of the lighting company led to a continuation of the contract system. The case of Toronto is a notable one, because the municipal sentiment is exceptionally well developed there. The local company is now performing lighting for the city at a figure a trifle less than was estimated as the cost of operation of a city plant. At Cleveland the local company holds the business because it made a price so near to actual cost that there could be no possible saving in municipal ownership, and the price was accepted after a careful inquiry into costs in neighboring cities on behalf of the municipality. The recent case of Tonawanda is another instance of success won on the same lines. There the local company submitted figures made by a recognized authority, showing the actual costs of operation in several representative municipal plants, and followed these figures by a bid more favorable to the city than municipal operation. I am assured that in each of these cities, while the contract figures are low, the management of the local company considers the business ultimately, if not directly, profitable.

THE REASON FOR PUBLIC LIGHTING BY CONTRACT.

In these instances the local companies have retained their public lighting business by demonstrating that it was to the interest of the municipality to let them retain it. In this they have put into successful practice the most important part of the policy which I advocate. I submit that the only sufficient reason why a municipality should contract with a private company for public lighting is that the private company can do the work, and is willing to do it, cheaper than the municipality can itself do it by the direct operation of a public lighting plant. It is in order to show how this comes about.

A DIFFERENCE BETWEEN PUBLIC LIGHTING AND PRIVATE LIGHTING.

There is no longer any question of the right of a municipality to own and operate its own public lighting plant. Electric street lighting is a distinctly public service, which must be provided for by the municipality. It is a service to every citizen; is a sequence of the social conditions which constitute city life as distinguished from rural life, and can only be effectively performed on municipal account and under municipal control. Herein it differs from the electric lighting of private premises, and it is necessary to note the difference. Electric lighting is the cheapest as well as the best light for streets and public places. For private premises, on the contrary, electric light is not a cheap light under usual conditions. It is not now, and is not likely to become, an illuminant of universal use, to the exclusion of gas and oil. Why this is necessarily so is well known to the members of the Association. To the general public it is a statement better proven by a couple of good examples than by a long statement of causes. In the city of Detroit there were, in 1897, according to the annual report of the Water Board, 52,219 supply connections to the city water mains and the "families" in the city were 54,945. Each "family" was certainly a user of artificial light of some kind. Illuminating gas of 18 candle power quality is sold in the city of Detroit at $1 per 1,000 cubic feet. The maximum price charged by the electric lighting companies for incandescent lighting is 14.4 cents per k. w. hour, including renewals of incandescent lamps; the minimum is 4 cents, and the system of charging makes the average price 10.8 cents per k. w. hour, which, allowing for difference in candle power, is equivalent to gas at $1.21½ per 1,000 cubic feet on the average, or to gas at $1.62 to the customer whose individual load factor obliges him to pay the maximum price. These are comparatively low prices, both for gas and electricity. Under these circumstances there are in the city of Detroit approximately 18,000 (?) customers for illuminating gas, and 4,000 customers for incandescent electric light. What light do the remaining three-fifths of the possible customers use? It is safe to say that they use kerosene oil. It is also safe to say that there are very few cases where oil is used merely because gas or electricity is not available. The main cause of the use of oil is its lower cost. I need not say to this audience, although I have found it necessary to make the statement to other audiences which were entitled to be considered intelligent, that there is not the least likelihood of the production costs of kerosene oil, of gas and of electric light materially changing their ratios to one another. As to their selling prices, I think that the Standard Oil Company is better satisfied with the profit which it makes on the sale of kerosene in Detroit, than are either the Detroit Gas Company or the electric light companies in that city with their profits.

I submit, however, a second example of the relative cheapness of gas and electricity, from which example the question of profit is eliminated. The city of Glasgow, Scotland, owns and operates its gas works and owns and operates its electric lighting plant. Neither of them is intended to make a profit. I have in my possession signed communications from the managers of each department in which it is written that the price of gas is two shillings and two pence per 1,000 cubic feet, and that the price of electricity for incandescent lighting (not including renewals of incandescent lamps) is six pence per k. w. hour for the first hour's use of the demand, according to a Wright meter. and 2½ pence per k. w. hour thereafter. Making the same corrections as in the Detroit calculation and assuming that the incandescent lamps paid for as "extras" in Glasgow, are as efficient as those furnished free by the Edison Illuminating Company, of Detroit, the Glasgow price for gas is 52 cents per 1,000, and the Glasgow price for incandescent lighting is equivalent to gas at $1.35 at the maximum rate, and 56¼ cents at the minimum rate. The average is about the same as the Detroit average. I think this example from a city where municipal own-

ership has been most thoroughly exploited, and where the municipal management is above suspicion of inefficiency or corruption, proves beyond question that electric lighting for private use is a luxury, and as such must continue to be used only by those who can afford luxuries; that is to say, by a minority of the citizens of any municipality; not by a majority, much less by every citizen.

Therefore, while it is admitted that the lighting of the streets is truly a public service, which may be performed by the municipality for and on behalf of every citizen, the furnishing of electric light to private consumers is not a public service, but is essentially a service to a few individuals, and as such should not be undertaken by a municipality whose object is to perform only those duties which municipal society as a whole owes to itself as a whole. This principle should be clearly understood, and should be boldly maintained. It is necessary that a municipality shall undertake certain services, and it is possible that it may undertake others, but the propriety of its undertaking any service depends on whether that service is to the public or to individuals; to the many or only to the favored few.

THE POSSIBILITY OF LOW CONTRACT PRICES.

This leaves to private enterprise the supply of electric light to private consumers. In performing this service there will be built and equipped a power house; there will be organized an operating and a managing force; there will be constructed lines of distribution. All of these may be, and part of them certainly will be, adapted to the performance of public lighting, in addition to the service of private consumers. To whatever extent this double adaptability exists in the private plant, there will be duplication of equipment in any other plant separately established for performance of the public work. Moreover it is peculiarly characteristic of public lighting operated all night that its addition to the ordinary work of a private lighting plant tends to reduce the average cost of the combined output. In these considerations rests the possibility of a contractor profitably performing public lighting for a city at or below the price at which the city can itself do the work, and yet it being to the interest of the contractor to undertake the business.

Let us for a minute assume that municipal engineering and management and municipal financiering can be just as good as private engineering and private financiering. If they are not so, it is the fault of the municipality, because technical and financial skill and executive ability are for sale in the labor market and are purchasable by a municipality, even as they are by private employers. There remains only one evident cause which should tend to make the costs of a municipal plant differ from that owned by an individual or a company. That difference is that the individual proposes to make a profit and the municipality does not. Looking closer at the facts we find that the municipality must in most cases allow the equivalent to a profit, because a municipal plant is built by money borrowed at interest. In the case where the money is not borrowed, but raised by direct assessment, the municipality has prevented some of its citizens from profitably using the money taken from them by taxation to be invested in the lighting plant, so that even in the exceptional case the possible profit to the taxpayer on the money withdrawn from his business has to be considered. But the rate of interest on municipal bonds is usually less than the rate to profit which a private owner is willing to accept on money invested in the electric lighting business. It is four per cent. as against six or seven or eight per cent. In the final analysis the difference between the cost of lighting by contract and that of lighting at cost by a municipally owned plant should not exceed four per cent. on the capital invested in the plant. I assume in making this statement that the rate of interest on city bonds is a fair measure of the profit that investors expect on a secure investment. If the investment in an electric lighting plant were equally secure, the rate of interest necessary would be no greater. The security depends so largely on the policy of the municipal authorities that it may approximate to that of municipal bonds on the one hand; or, on the other, it may be of the same order as the stock of a speculative gold mine or a Klondike expedition. In saying that the difference should not exceed four per cent., I am to be understood as implying such conditions as take the investment out of the speculative class. I am also to be understood as implying that proper salaries for management have already been paid out of earnings, and that the profit mentioned is that payable to capital alone; in other words, an exact parallel to the payment of interest on a municipal bond.

THE ADVANTAGE OF THE CONTRACTOR.

It follows that if the organization and equipment of an existing plant engaged in the supply of electric light to private consumers is available for the purpose of performing public lighting, this maximum difference of four per cent. can be thereby reduced or even reversed. In every case the difference should be reversible. There are causes to be considered later which tend to the contrary, but the fact remains that there is no irremovable cause why an existing electric lighting plant should not be able to perform public lighting at a less price than the municipality can do the work itself.

THE DISADVANTAGE OF THE CONTRACTOR.

Of the causes which tend to the contrary, one is that the plant which has a contract for public lighting may have very little private service, or none at all. Some other plant in the same city may do all or most of the private business. This condition of affairs can be only temporary. The consolidation of the two plants is an economic necessity, certain to arrive in time. The only condition justifying the existence of two plants in the same city is that the city is so large as to make a division of territory desirable; and even in that case an operating agreement is to be preferred to complete independence.

The public has been told that consolidation of plants is not to the public interest. This is an error, and the way to prove it such is to give to the public the surplus profits of consolidation in the shape of lower rates and better service—either or both.

Another cause tending to handicap the contractor is that few municipalities will make contract for a long term of service. Even the advocates of municipal ownership who are willing to issue twenty or thirty year electric light bonds, and who will not write off more than three or four per cent. for depreciation of plant in making their estimates of city operation, will protest against a contract running more than a year or two. They claim for the municipal plant all the advantage of a secure investment, and simultaneously deny these advantages to the contractor. We know that the securing of a long-term contract permits the installation of the most economically operated machinery, and reduces the percentages of profit, which must be earned annually. The objection to the long contract, that it denies to the city any share in the profits of possible improvements effected during the term of the contract, can be met by so drawing the contract that the margin of profit shall plainly be reasonable to begin with, and that the city may share in the results of improvements in consideration of guaranteeing a similar reasonable profit on the investment to be made in such improvements. A ten or twenty year contract with such a clause could be safely taken at a very low price.

A possible solution of this problem is city ownership of the plant, combined with operation by a contractor. I think that this plan may by and by become common. It involves too many details to permit of my discussing it at present.

CAPITAL ACCOUNT.

The very worst handicap that a contractor may have to carry is excessive capitalization. Here it must be noted that many municipally owned lighting plants do not report all their capital expenditure, so that in carelessly made comparisons of fixed charges the contractor appears to have overstated his investment in order to increase the apparent cost of operation. Any comparison must be on an identical basis for capital as well as for operating charges. And for the purpose of adjusting prices between municipality and contractor, only one basis for capital charge is acceptable; namely, the present value of the plant in brief, a properly made inventory. This proposition is so radical that I state the reasons for it.

The possible bases for a capital charge are as follows: First—The face value of the securities issued by the plant. That this is an impossible base of adjustment is too well known to all electric light men. Second—The current market value of these securities. This is impracticable, because many securities are not on the market, and because the immediate earning capacity of a plant affects the price of its securities, and because—last, but not least—some securities are speculative rather than industrial. Third—The actual cost of the plant. This would be proper if all plants had been built at the same time and if no plant had been obliged to be rebuilt. As it is, the construction cost of two plants built, the one in 1888 and the other in 1898, the two of

identical capacity and of similar type, may be to one another as two to one; the earlier plant may have cost twice what was paid for the later, solely because of the reductions in the prices of machinery and material of construction in the last ten years.

The only remaining possible base for a capital charge is the present value of the plant; and I do not think that any other can be made acceptable for the specific purpose of adjusting a price for public lighting. It does not follow that the capital account is to be readjusted to a corresponding figure. It is only requisite that the company accept as a proper profit on public lighting business an allowance based on inventory value of the investment. It would be well for the industry, however, if all our capitalizations were brought near to present values. And one good result of revaluation would be a logical sequence—the depreciation of the investment from year to year would necessarily be admitted as a proper charge against revenue. If a profit is only to be allowed on capital sufficient to construct a plant at the comparatively low construction prices now ruling, any further decline in cost of construction must be considered an impairment of capital, to be made good before any profit can be paid. It is not to be understood that I expect an electric lighting company to stop dividends or to reduce capital stock in order to make good in any one year an extraordinary depreciation charge, due, for instance, to the replacement in the year of old type machinery with new, in order to meet a public demand for a higher grade of service. Such extraordinary charges must be financed according to well understood rules. The loss of value of the old machinery does not occur in an instant, but is a process continuing through several years. So far as it is possible, this loss of value should be anticipated by charges made in advance—in other words, by the accumulation of a renewal fund. But where this has not been done the charges should be distributed over a proper period with due regard to all interests involved—in other words, so as to secure the greatest good for the greatest number. The principle is all important. The detail as to how a proper depreciation charge shall be put on the books is a matter to be disposed of in the most convenient manner.

IN CONCLUSION.

Having recited my premises, I now state my proposed policy as a recommendation, as follows:

I recommend that the association declare by resolution:

1. That a municipality may properly provide for public lighting either by the ownership and operation of an electric lighting plant, by the operation of a contractor under lease of a municipally owned plant, or by contract with the owner of a private plant.

2. That the supply of electric light to private users is not properly a municipal function.

3. That the performance of public lighting under contract by a private plant in connection with the supply of electric light to private users is essentially the method of least expense.

4. That the existence of two electric lighting plants in the same territory is an economic error tending to increase the cost of production, and thereby the selling price; and that the maintenance of competition is to the detriment of the public.

5. That public lighting by contract should be performed at the lowest price consistent with a reasonable profit on the value of the investment; that no electric lighting contractor should demand more than such a profit, and that each municipality should protect the contractor in the enjoyment of his profit, and against impairment of his investment, in order that a minimum profit may become reasonable.

6. That in order to adjust prices in the absence of competition it is necessary that costs be ascertained and prices approved by a competent authority, acceptable to the public as well as to the contractor.

7. That in the absence of a constituted authority competent to ascertain costs and prescribe prices, members having public lighting contracts under consideration should endeavor to have the adjustment of the contract price undertaken by a temporary commission, or arbitration committee, who will adopt as the basis of adjustment the principles set forth in these resolutions, particularly in resolution number 5.

8. That there is no essential difference in the organization of municipally owned plants requiring a different analysis of costs from that which is proper for private enterprises, and that the publication of the costs of municipal lighting plants properly analyzed is beneficial to the electric lighting industry. Further, that the similar publication of the costs of private plants is desirable, but is at present impossible because of its advantages to actual or possible competitors.

In conclusion, I desire to say that the tendency of public opinion appears to be toward some interference by and on behalf of the public with corporations performing so-called public services. Such a tendency is a concomitant of our social progress. It is not merely a temporary surge, but is a part of a general movement. It cannot be withstood, but may be guided into proper channels. The general result of any such movement is for good; the damage which is done to individual rights is incidental and is more often the result of needless opposition by the individual. In this matter of public lighting the right of the community to interfere is so evident that it has been one of the first subjects considered, and will be one of the first disposed of; and its priority in time will establish its disposition as a precedent for the future disposition of similar questions. There is immediate need for clear thinking and for well-considered speech and action—for speech telling the public that electric light companies desire to do business according to the golden rule, and for action plainly in conformity with the speech. I believe that this association can appropriately speak for its membership, and that its members are willing to live up to the principles which the association may enunciate.

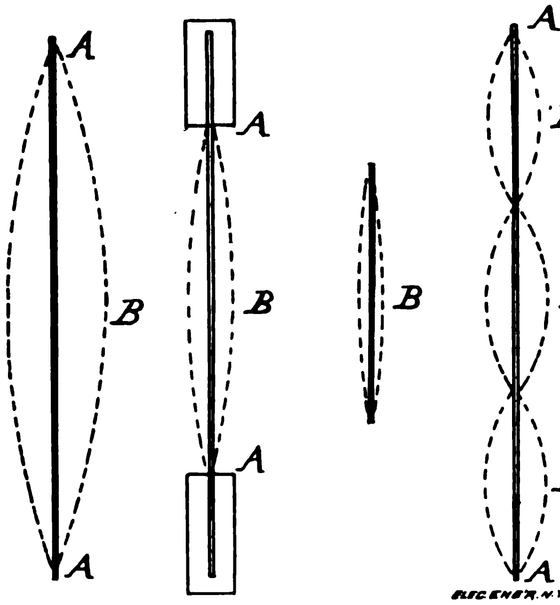
TELEPHONY AND TELEGRAPHY

Practical Features of Telephone Work.—XV.

BY A. E. DOBBS.

INSPECTION OF APPARATUS.

THE first thing I should do after an examination of the switches, generator and ringing apparatus would be to take the transmitter apart. The tendency among many manufacturers of telephones has been to make the transmitter diaphragm too small, which is theoretically wrong; and another is to spread the granulated carbon out over the whole back side of it, which is wrong again; and the fact that some of these have



FIGS. 44, 45, 46 and 47.

attained a fair measure of success, does not prove that the theory is wrong, but rather that the small variations of current used in telephone practice will be transmitted in spite of inefficient appliances.

Some makers are already beginning to find this out, and we find the carbon diaphragm constantly getting larger and the back plate for holding the granules getting smaller, while others have abandoned the carbon diaphragm altogether, using

a thin sheet steel in its place, producing a transmitter which talks and acts much like the American Bell solid back, which has been the most powerful and efficient instrument in the recent past; and we may add, has never been excelled in commercial practice except by those mechanical contrivances known as the acoustic telephone, which had a diaphragm at least six inches across. Up to their limit—which is about two miles—these possessed a perfection in transmitting conversation which has never been possessed by their electric rivals, and while their troubles were many and various, no electrical instrument on the market has enabled people to carry on a conversation with other persons from all parts of an ordinary room.

Were it not for the fact that it is so sensitive to weather changes, parchment, which was largely used in these instruments, would be an ideal material for both transmitter and receiver diaphragms; but even when covered with shellac it would require considerable attention and adjustment. Even carbon has its faults, one being its porosity, which allows dampness from the breath to work through to the granules on the back side, and most of the "packing" in the Hunnings type of transmitter comes from this cause, the moisture causing the granules to stick together.

Some makers cover the front of the diaphragm with varnish, which is a very good way, and one uses a thin layer of oiled silk, which, it seems to me, must have a slight muffling effect, though he takes so much pains with other parts of his instrument that he gets good results in spite of it.

This quality of carbon has led some manufacturers to the use of steel in their diaphragms, which has not this objection, and which is very sensitive to sound waves, though it has a metallic tone, which is objectionable.

The size of the diaphragm is of more importance than at first appears, for, in the most powerful transmitters, the free swinging surface of the diaphragm has a diameter of about three inches, and if I were manufacturing telephones I should experiment with still larger sizes. One of the best telephones I ever talked over had a cork diaphragm and a vibrating surface of about six inches. One manufacturer to whom I spoke in regard to this referred to the damper spring used on all Bell instruments to prevent too free a vibration, but this is simply used to prevent the resonance of the steel diaphragm, and is always used with a cushion of soft rubber; and every instrument man knows that should this rubber become worn out or brittle, or the spring a little too tight, that the conversation weakens proportionately. Those who have studied acoustic and musical instruments understand this perfectly.

Our present knowledge of vibrating surfaces indicates that the diaphragm vibrates as a whole, as shown by Figs. 44, 45 46 and 47. A glance will suffice to show that in order to swing freely the edges of the diaphragm should not only move freely, but that the range of greatest variation between the diaphragm and back contacts would be at the centre (B). In Fig. 45 notice how the vibration is reduced by having the edges tightly clamped, and in Fig. 46 the difference between a small one and the one shown in Fig. 44.

In the instruments known as the "solid back" there is a small button fastened to the centre at B, which still further assists in swinging this centre to and fro; and we may mention that the acoustic telephones also had a button in the centre for the same purpose. Even if the diaphragm vibrates in nodes, as shown in Fig. 47, the centre is still the most important part.

And carbon granules placed all the way up and down the width of this surface only retard its movements, and the battery variation caused by the movement at the centre may be almost completely neutralized by the comparatively stationary carbon at the edges.

Of course, there is such a thing as too free a vibration, in which case we would get loudness, at the expense of clearness, and this explains in a measure why the long-distance telephone is sometimes heard more distinctly at two or three hundred miles than when used for local business. In the former case the lighter over-tones, which have a tendency to jumble and confuse the articulation on short lines, are eliminated by the longer line resistance, which, while leaving the articulate sounds somewhat weaker, also frees itself from the objectionable ones. The form of the mouthpiece also has more to do with the talking qualities of a transmitter than is generally supposed. It should not lie too close to the diaphragm, as the back pressure of the air in the confined space would muffle it, nor should there be too much space, as much of the concentration effected by the mouthpiece would be lost.

LITERATURE

Publications and Proceedings Reeeived.

VOL. 14, No. 2, of the proceedings of the Engineers' Society of Western Pennsylvania, containing the minutes of the regular meeting of February 15, and the lecture before the chemical section on "The Municipal Laboratories of Hamburg, Germany," by J. O. Handy, and the report of the Committee on Roads and "the Relation of Our Rock Formation."

THE CANTON LECTURES ON "GUTTA PERCHA," by Dr. Eugene F. A. Obach, F. I. C., F. C. S., M. I. E. E., delivered before the Society for the Encouragement of Arts, Manufactures and Commerce, London, November and December, 1897. The book contains three lectures, the first being on the raw material, the second on the cleaning processes and the third on the cleaned material. The book is profusely illustrated, and is a complete and interesting treatise on this very important topic. A historical treatise and a number of valuable tables are appended to the book.

A LECTURE ON "GAS AND OIL ENGINES," delivered by Thomas L. Wilkinson before the Colorado Scientific Society in Denver, March 5, 1898. The author treats the subject in an exhaustive and practical manner, showing the advantages and disadvantages of the most modern types of gas and oil engines and illustrating his lecture by numerous tables and illustrations.

VOL. 12, NO. 7, OF THE SIBLEY JOURNAL OF MECHANICAL ENGINEERING, published by the students of Sibley College, Cornell University. It contains a portrait and short sketch of Prof. H. Wade Hibbard, the recently-elected principal of the new graduate school of railway mechanical engineering of Cornell University, and articles on "Electric Railway Motor Design," by Messrs. E. C. Sickles and E. A. Wagner; "Singular Stress-Strain Relations of Rubber," by Prof. R. H. Thurston; a new art of industrial drawing, department notes, editorials, etc.

UNIVERSITY OF WISCONSIN. A very handsome pamphlet, measuring 11x15 inches, entitled "Picturesque University of Wisconsin," which was issued in commemoration of the fiftieth anniversary of the college, and was edited by William Herbert Hobbs, has been received. It contains a complete history of the university and a description of the various schools of the university and a few hundred illustrations. A great deal of space is devoted to the electrical engineering department, which is in charge of Prof. D. C. Jackson. Judging from the description and the work done by this department, it certainly shows that the electrical engineering course ranks among the most practical taught in any of the American universities. It is interesting to note that in connection with this department is a laboratory for electrolysis, which is probably the first thorough equipment of the kind that has been installed in an American engineering school.

ACADEMY OF SCIENCE, OF ST. LOUIS. An illustrated pamphlet entitled "Discussion of Series Dynamo Machines," by Carl Kinsley, has been received, and is an abstract of a paper read before the Academy of Science, of Louis, April 18, 1898. It contains valuable data on and a thorough discussion of fundamental considerations from which the dynamo and motor surfaces are obtained, and a generator driving a single motor running at constant speed under all loads. Also valuable data obtained from tests of particular machines. The pamphlet is No. 7 of Vol. 8 of the Transactions of the Academy.

WORCESTER POLYTECHNIC INSTITUTE. The catalogue for the current year of the Worcester Polytechnic Institute, Worcester, Mass., has just reached this office and contains much valuable information on the splendid technical courses of

this institution. The electrical engineering course requires a thorough training in mechanical engineering, to secure which the work of the first three years is made practically the same as that of the mechanical department. It is considered of equal importance that considerable time be devoted to purely electrical engineering subjects, so that those students who have taken two years' work in mechanical engineering, and wish to follow the electrical course may elect to do so at the beginning of the junior year and become candidates for the degree of S. B. in electrical engineering. In the senior and graduate years extended courses are offered on the theory and technical application of electricity, in laboratory work and in electrical design, together with advanced space in related lines of engineering work. In connection with these departments should be mentioned the Salisbury laboratory, the magnetic laboratory, the engineering laboratory, power laboratory, hydraulic testing plant and the Washburn shops. We have also received Vol. I, No. 3, of the Journal of the Institute which is a very creditable publication, and contains in this March issue the following articles: "The Boston Subway," "History and Development of Triangulation in Massachusetts," "Printing of Cotton Fabrics," "Modern Thermodynamics," "The Development of a School of Electrical Engineering," "The Efficiency of the Steam Separator," and others.

LETTERS TO THE EDITOR

Hunter Car-Control Patents.

In your issue of June 16, page 681, the letter from me which you published gives the impression that the exclusive license to all of the controller patents of the Electric Car Company of America passed to the Thomson-Houston Electric Company. I wish to correct this, for, as a matter of fact, the Thomson-Houston Company, and through it the General Electric Company, only have a license for the exclusive use of these inventions upon trolley railroads or such roads as supply the motors with current by means of line conductors. The rights under these patents for all electric vehicles using storage batteries, such as carriages and accumulators, I caused to be transferred to the General Electric Automobile Company, which has been recently organized, and whose headquarters are in the Bourse building, Philadelphia.

R. M. HUNTER.

NEWS AND NOTES

Brooklyn Elevated Begins Its Bridge Service.

ON the morning of Saturday, June 18, the Brooklyn Elevated Railroad Company, who are equipping their extensive lines with electricity, as described in our issue of March 3, inaugurated their through service from Manhattan Borough to Manhattan Beach, by running a special train over the entire route without making a single stop. The guests who had been invited by the railroad company filled the five cars, which left the Manhattan end of the bridge at 11.30 a. m. The run was made direct to Sheepshead Bay and Manhattan Beach, via the Fifth avenue line, the inclined plane at Thirty-sixth street and then leaving the tracks of the Culver route, over the Long Island Railroad's Manhattan Beach division. The train was propelled from the terminal by means of one electric motor car, equipped with four 80 horse power Walker motors weighing 3,900 pounds each, until it reached that portion of the structure where the cable was picked up by the grips on the other four cars. These are fitted with side doors and are similar to regular bridge cars. As the train emerged from the Brooklyn terminal one of the elevated locomotives was coupled on and the train was propelled by steam to the seashore. This is the first time on record that a train propelled by electricity, cable and steam has been run direct from Manhattan to the seashore, and the honor of operating the train fell to General Superintendent I. D. Barton of the Brooklyn "L," who ran the motor and the engine on the trip down. From the Manhattan terminal of the bridge to the Manhattan Beach Hotel the run was made in 37 minutes and 50 seconds. This was unusually good time and was due to the fact that no stops were made. The railroad officials say that the regular running time for this distance, with regular passenger trains and all stops, will be fifty minutes. The trolley roads cover the same distance in a little over an hour. At the seashore an elaborate luncheon was served at the Manhattan Beach Hotel and the three hundred guests of the elevated road completely filled one of the big dining rooms.

In the words of ex-Mayor Fred. W. Wurster: "The running of through elevated trains over the bridge and the consequent increase of transportation facilities to the people of Brooklyn, as well as the resultant benefits in the shape of expected increased population and material growth, makes this an event of historical importance to this borough."

Cable Cutting.

Mr. James Brown, superintendent of the Direct U. S. Cable Co., of this city, sends us as worthy of note the following item from the London "Electrician" of June 10:

"With reference to statement made in daily press, that if the United States interrupt telegraph communication with Spanish colonies, Spain will retaliate by severing the cables between the United States and Europe, we desire again to point out in the strongest manner the futility of such an attempt, which would only result in injury to neutral property, without effecting the desired object, and would inevitably lead to heavy claims for damages, to say nothing about the practical impossibility of breaking some twelve or thirteen cables before those first severed are repaired. We have it on the authority of one of the Atlantic companies that they have transmitted readable code words through a cable 500 miles long, broken about midway, by means of apparatus invented by A .C. Brown, of the Single Wire Multiple Telephone Signal Co."

Electric Power From the Catskills.

The Ramapo Water Company has a plan to develop electrical energy in great quantities from the watersheds of the Catskill Mountains. It has obtained control of over 1,000 square miles of watersheds in the counties of Rockland, Orange, Ulster, Sullivan, Delaware, Greene and Schoharie. The company believes that enough power can be developed to run all the electrical and surface cars in this city.

Mr. Lauterbach, counsel for the company, says that the details of the plan were not ready to be made public. "If Niagara Falls were near our doors the city would naturally be deriving an enormous benefit from it. But as it isn't we are going to do what we can with water power that is not so far away."

La Capital Electric Railway, Buenos Ayres.

American supplies are being almost exclusively used in the equipment of the La Capital Electrical Railway, of Buenos Ayres. The rails are 90-pound grooved girder, made by the Johnson Company, the bonds Edison-Brown plastic and Syracuse soldered. The entire rolling stock was built by the J. G. Brill Company, mounted on Brill trucks and equipped with General Electric motors. The iron poles were furnished by Morris, Tasker & Co., and the overhead material by the W. H. Johns Company. In the power house three vertical Ball & Wood engines are coupled direct to Walker generators. Steam is supplied by four Sterling boilers of 250 horse-power. The plant includes Green's fuel economizer, Conover's condenser and two Worthington pumps.

BALTIMORE, MD., has voted to build a municipal system of electrical subways, under a board comprising the mayor, city register and president of the fire commissions, and with a chief engineer at a salary not exceeding $4,000 per year. Bonds for $1,000,000 may be sold for the prosecution of the work.

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The Development of Automobiles.

ON the surface, in this country, there have been very few indications until recently of any activity in the field of automobile traction, but it would seem that a new departure is about to be made. The display of several vehicles at the Electrical Exhibition was encouraging, and the carriages themselves were far in advance of anything hitherto brought to notice. This month again a new type of electric carriage is being shown at the Philadelphia Exhibition, and the news comes of the formation of an important new automobile company there, as well as the entrance into the field of the Indiana Bicycle Company, a well-known, leading concern in the West, which has acquired control of the American Electric Vehicle Company, of Chicago.

All this is promising and appears likely to put this country in line with France, where automobiles are shown by the present exhibition in Paris to be both numerous and popular. In some respects, these developments may put us ahead of France, where promoters and engineers are still pottering along with oil, gas and steam locomotives that will assuredly drop to the rear at no distant date, while electrical machines will as certainly come to the front. In this country all the more serious efforts would now appear to be making along the line of electricity, and work in other directions has the air of petering out. We believe that the electrical methods in use will soon improve materially. We can but agree with Mr. J. T. Niblett in his recent address before the Self-Propelled Vehicle Association at Liverpool, when he said: "The modern secondary battery leaves very much to be desired, but still there are several very good batteries for this purpose obtainable." One of the chief points now to be worked out is that of supply, and we cannot see why our direct current low tension stations should not, in all the large cities, be able to build up a large new business in service of this character at specific sub-stations where cabs, express wagons, buggies and other vehicles can plug in, charge up and pay for what they get there and then, or under contract. In minor cities, also, there is an excellent opportunity thus coming for a new market for current, and 1900 should see the streets of America much fuller of electric automobiles than they now are of trolley cars.

The "Demon" Fan Motor.

IT had to come at last, and the "deadly" trolley now finds an associate in crime in the "demon" fan motor, as the New York Journal, with wonted understatement, calls it in a recent news item. We have heard the fan motor described as "the pneumonia screw," but this is much stronger language, although people who have interposed their fingers among the whirring blades have perhaps matched it. The Journal tells how in a palatial free lunch saloon in aristocratic Jersey City a fan motor, at high noon, when the lunchers thronged thickly, tipped off its perch, gashed the face of a bartender and plunged madly into the dishes of tongue, beets, crackers, cheese, etc., "with a clatter that could be heard for blocks." The lunchers fled in dismay, the free spread was ground to powder, and the motor "seemed to pursue in turn everyone within the length of its cord." One man who went to the bartender's aid had his legs cut by the fiercely revolving blades, and there was promise of further carnage when a heroic policeman bethought himself to turn the key switch and stop the current. By this time "the saloon was a mass of hash, broken dishes and two bleeding men," and the fan motor had won for itself a name as the "demon" and a place in history. When we remember that idle stockbrokers sometimes use fan motors as a means of gambling by putting numbers on the blades and betting on them, it will be seen that we are dealing with a new social monster which must be forthwith suppressed—just as the "deadly trolley" was.

The Use of Röntgen Rays on the Battlefield.

PEACEFUL as its mission is in advancing and spreading civilization, not less potent is the influence of the electric current in its numerous applications upon modern warfare. Whether this relates to its innumerable uses on shipboard or the defense of our harbors, the transmission of intelligence by means of lights, telegraph or telephone, or the explosion of mines, in every department has it become a useful and indispensable servant when entrusted into intelligent hands. Little, however, has been said, and not much more, perhaps, has been done, regarding the use of the Röntgen rays on the battlefield, in the hospitals and tents, for relieving the pains of wounded and suffering soldiers. This fact is not to be ascribed to any fault of the apparatus or inadequacy to do the work for which it is intended, but it is due rather, judging from recent remarks by Surgeon-General Sternberg, to a prejudice against, or too little knowledge of, the intelligent use of the rays. This is very much to be regretted. If it is evidence of utility the authorities want, let them peruse the recent lecture by Surgeon-Major W. C. Breevor, before the Royal United Service Institution of England, who based his remarks on the result of experiences he gained during the recent operations on the Northwest Frontier of India. He dwelt at length on the employment of Röntgen rays in military surgery and proceeded with the aid of magic lantern slides to give cases of interest from the campaign. These consisted of bullet wounds sustained by officers and men who had injured bones, joints and internal organs, baffling the skill of surgeons to ascertain their exact position, and which, but for the application of the X-rays, must have resulted in amputation of limbs and probable loss of life. The pictures included wounds in the arm, chest, leg, back, finger and other parts of the body. In every one of the instances enumerated,

the bullets were, by the use of the rays, successfully removed, the men subsequently rejoining their comrades at the front. He then gave details of the requirements of an X-ray outfit for easy transport in the field.

This is the experience of an intelligent English officer, which deserves recognition, and has been repeatedly borne out by experiences in our own country in times of peace. Should the officials decide to employ such apparatus on the proper scale, electrical manufacturers could furnish portable outfits in short order, any number of men could be found or trained to handle them, and by a speedy introduction of this great life-saving device many of the horrors of war may be alleviated or removed.

The Value of Consular Reports to the Electrical Industry.

DURING these stormy times and diplomatic complications we have heard considerable about the necessity of the proper training of the foreign representatives in whose hands are so largely entrusted the interests of our country. Not alone, however, should they possess a knowledge of the law of nations so as to be able to defend our rights and honor, but they should be equally well trained in the commercial interests and needs of the people. They should carefully guard and increase our commerce, and lend their aid to the extensive introduction of American machinery and products. That this last matter has not been lost sight of by some of our representatives abroad is evidenced by a recent letter of United States Consul Liefeld at Freiburg, Germany, to the Scientific American advising American manufacturers of the fact that an electric railroad is about to be built at that place and enclosing circular letters, plan of the city, plan and profiles of the projected enterprise, etc., and advising them to whom and up to what time to submit their bids. In a similar manner other consuls from time to time publish items of great interest to American electrical manufacturers, so that no large electrical concern should now be without the consular reports issued daily by the Bureau of Foreign Commerce, Department of State, and sent free to anyone on application. Consul Liefeld's course is to be highly commended and should be widely followed by his associates to whom, we are sure, the columns of the technical press are freely open at all times.

The Municipal Right to Govern Wrong.

ONE of the interesting papers at the Chicago N. E. L. A. convention was that of Mr. Dow on the fundamental principles of municipal ownership and operation. The paper is the more valuable because it is moderate in tone, even in temper, and argues the question out with sweet reasonableness. The paper closes with a series of propositions which Mr. Dow wanted the association to adopt, but which were not, we believe, altogether acceptable, and which are not likely to become its platform under existing conditions. For instance, Mr. Dow wished to have it declared that "a municipality may properly provide for public lighting either by the ownership and operation of an electric lighting plant, or, etc." Now that is the very principle the members are likely, individually and collectively, to fight tooth and nail; and one which we should certainly object to, even if every one of them voted themselves thus out of existence. There are good municipal plants, and many good men running them, but we believe and are convinced that as a general thing it does not pay any community to undertake for itself a service it can get done under contract. We say "does not pay" and are willing to rest the issue on that ground alone. There are other grounds, and broader, but that will suffice.

OBITUARY

Bernard Moebius.

Bernard Moebius, inventor of the electrolytic process of parting and refining gold and silver which bears his name, died recently on board the Kaiser Wilhelm der Grosse while on his way to his old home in Germany. Mr. Moebius succeeded in 1884 in solving the problem of economically and rapidly extracting the precious metals from their ores by electricity. He improved his invention in 1895, and now both the old and new processes are in successful operation in Europe, Mexico and the United States. Mr. Moebius engaged in mining in Germany, Austria, Spain and Mexico before settling in the United States, of which he became a citizen.

LEGAL NOTES

Foundation Reversible Trolley Patent Suit Dismissed.

THOMSON-HOUSTON ELECTRIC CO. VS. UNION RAILWAY CO. AND WALKER CO.

Judge Shipman in the U. S. Circuit Court for the Southern District of New York has dismissed the above suit for infringement brought under the Van Depoele patent No. 495,383, claims 11, 12 and 13, covering the use of the reversible trolley. Judge Shipman noted that the patentability of the three claims had already been decided against in the Winchester avenue case by Judge Townsend, under this patent and No. 495,443, but said in considering the matter again: "The necessities of the new underrunning trolley system called for the improvement, but the idea of pivoting the contact arm to a rotating support, to which the spring is also attached, rather than to the car, must have been within the capacity of the ordinary mental equipment of the skilled mechanic."

No Appeal in the Milwaukee Four-Cent Fare Case.

It is stated that the attorneys for the city of Milwaukee in its unsuccessful suit against the Milwaukee Electric Railway and Light Company, to enforce the Common Council's four-cent-fare ordinance, had virtually determined not to appeal the case further. The city attorney is quoted as saying that any additional litigation would only lead to useless expense.

The defendant company, which received a favorable decision in the suit about a fortnight ago, will, of course, stand on the verdict, but would have preferred, it is said, to have had the case taken through the Appellate and Supreme Courts, in order to reach a final adjudication. This was regarded as of especial importance in the present case, because it is "new law," and a final decision in the highest courts would have made it directly applicable to all similar cases which might occur anywhere in the United States.

Diehl Motors.

The Diehl Manufacturing Company notify us and the trade that they have brought suit against Royce & Marean, of Washington, under patents Nos. 465,360, 465,361, 537,679 and 585,250, relative to fan motors.

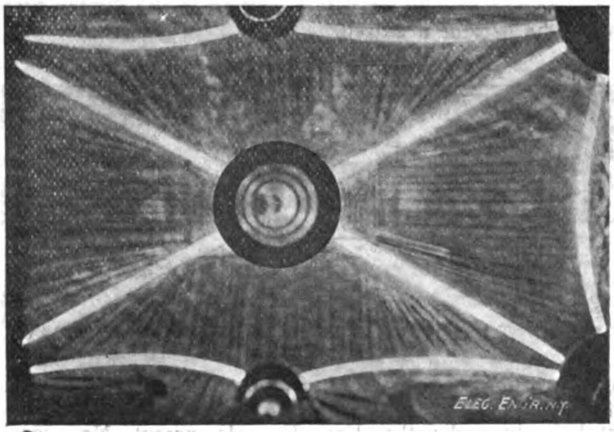
THE OMAHA EXPOSITION has been duly opened by President McKinley with the aid of the telegraph and the long distance telephone, and the exhibits are rapidly getting into shape. The show is a very fine one and typical of the central West.

THE PHILADELPHIA ELECTRICAL EXHIBITION.

JUNE 6 TO JULY 6.

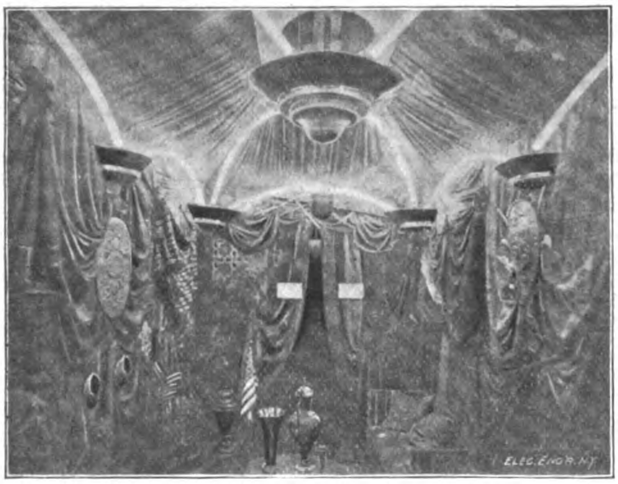
The Moore Vacuum Tube Exhibit at the Philadelphia Electrical Exhibition.

UNDOUBTEDLY the feature of greatest interest to the visitors at the exhibition, both on account of its novelty, as well as the beauty of its arrangement, is the Turkish smoking room illuminated by means of Moore's vacuum tubes. Very few people discover that the vacuum tubes used in this room are the same that were used on the arches of the beautiful chapel at the recent show in New York. They appear here



ARRANGEMENT OF TUBES ON CEILING OF THE MOORE TURKISH SMOKING ROOM.
(Photographed by light of tubes.)

under entirely different conditions. Instead of adorning a sacred edifice, they now light up the rich colors of the oriental hangings of a Turkish smoking room. The distribution of the tubes, producing an ideal effect, is shown by the accompanying illustrations. The photograph of the interior, as well as that of the ceiling was taken by the light of the tubes themselves, which brought out the beautiful details of the richly colored tapestry, as well as if daylight itself had been used. The apparatus for producing the light is the same as that used at the New York



INTERIOR OF THE MOORE TURKISH SMOKING ROOM.
(Photographed by light of Moore Vacuum Tubes.)

show, and was described in our pages in the issue of May 12. Many favorable comments have been passed by visitors on the great similarity between this light and daylight, its softness and great light giving power without producing any heat. Mr. Moore has now so far perfected his apparatus as to be able to produce a bright steady light, practically devoid of fluctuation or interruption. He has demonstrated its adaptability for interior illumination, certainly showing by the two exhibits its wide range of usefulness. Reliable data as to the efficiency and light-giving power of these tubes will, we understand, soon be forthcoming, and it will be awaited with a great deal of interest by every one.

Some Exhibits at the Philadelphia Electrical Exhibition.

WE make running note below of several of the principal exhibits:

The Bell Telephone Company, of Philadelphia, have a long distance telephone and public pay station.

American Feather Flower Company, 144 North Seventh street, Philadelphia, Pa., have show case with exhibit of feather flowers and an exhibit of the manufacture of feather flowers with decorative lamps inserted.

United Electric Improvement Company, Nineteenth street and Allegheny avenue, Philadelphia, Pa., manufacturers of direct current dynamos and motors, alternating current apparatus for central stations, switchboards and instruments; rewinding armatures and general electrical repairs; incandescent lamps for all systems of electric lighting, colored and ornamental lamps, miniature lamps of any candle-power or voltage. This company exhibit in their handsome booth, an illustration of which appears on this page, a great variety of the above products. On a

EXHIBIT OF THE UNITED ELECTRIC IMPROVEMENT. CO.

plush-covered panel at the back of the booth are arranged innumerable incandescent lamps and in the centre is a 12-inch fan motor in operation. Above the board are placed several "Mogul" lamps of 150, 250 and 500 c. p., 110 volts. They have in operation a complete incandescent lamp manufacturing plant and make miniature lamps on the spot, which, with pin attached, they give away as souvenirs. They also exhibit bipolar and multipolar generators, and a mercurial vacuum exhausting pump. Special carbons are also shown and the exhibit is in charge of Mr. W. E. Smith, assisted by Messrs. W. and James T. Jukes.

American District Telegraph Company, 1031 Chestnut street, Philadelphia, Pa., have a public telegraph office.

Dr. Marcus Rothschild, Bourse Building, Philadelphia, Pa., has an exhibit of electrical power lens grinding apparatus.

George M. DeGinther, Eleventh and Walnut streets, Philadelphia, Pa., shows Holaphane globes of great variety of styles and sizes in a handsomely fitted up booth.

Alfred F. Moore, 200 North Third street, Philadelphia, Pa., has an exhibit of single and double cotton-covered armature wire, single and double silk-covered wire, annunciator and office wire; weather-proof wire, fire and weather-proof wire, telephone cords, incandescent lamp cords, telephone switchboard cords, telegraph switchboard cords, rubber-covered line wire and special duplex telephone line wire.

Williams, Brown & Earle, 918 Chestnut street, Philadelphia.

Pa., show the electrical centrifuge for the rapid sedimentation of liquids by means of centrifugal force, and for the examination of blood, and for bacteriological work. The following electro-therapeutic apparatus is also shown: The electro-galvanic controller, Dr. Massey's electric controller and galvanic cancer battery and the electric cautery controller. Also the following electric projection apparatus: The electric projection magic lantern, spectroscope and microscope.

Morse, Williams & Co., 1105 Frankford avenue, Philadelphia, Pa., exhibit several elevators, as follows: Large size direct-connected winding drum electric elevator for 350 feet per minute car travel for passenger service, or 10,000 pounds at slow speed for freight service, with attached motor and variable speed controller. Small size factory belt ceiling machine driven by reversible motor and single belt; with motor and controller arranged to show usual manner of erection and operation in factory. Model of direct-connected electric passenger elevator, suitable for residence service and adapted for automatic push button control. Model of Hindley worm and wheel showing type of worm and wheel used by Morse, Williams & Co. in all their direct-connected electric and belt-driven hoists.

Walker & Kepler, 531 Chestnut street, Philadelphia, Pa., make an exhibit of Lundell dynamos and motors, direct-connected fan outfits, organ blowing outfits, ceiling and desk fans and Sprague electric elevators; telephones, heating apparatus, switchboard instruments, bell and gas lighting supplies, electric lighting supplies of all kinds; iron-armored conduit and fittings, pole-line material; Pioneer arc lamps, Imperial incandescent lamps; gas, electric and combination fixtures and shades.

The Sprague Electric Company show Lundell fans and motors and an Estey Phonorium with Lundell motor outfit.

Westinghouse Electric and Manufacturing Company exhibit a 60 k. w., 190 volt multipolar generator, designed for charging storage batteries, direct-connected to a new 3-cylinder type Westinghouse gas engine. This engine embodies in a general way features which have made the Westinghouse steam engines so popular and successful; the upright, self-contained construction and self-lubricating principle being particularly apparent. The valve actuating mechanism is located inside the crank case where it is protected from dirt and grit and where it is constantly and copiously lubricated. The valves themselves are of the "poppet" type, positively actuated, impossible to clog, and having no rubbing surfaces to wear or cut. One of the main difficulties with gas engines has been that of regulation. The good regulation of this engine is secured by building it with three cylinders and giving several impulses at every revolution. It regulates for changes of load by varying the amount of the explosive mixture delivered at a charge, but it receives several impulses at every revolution, whether running fully loaded or entirely light. On this account it compares favorably with the best steam engines in smoothness of running and regulation.

Standard Fireproofing Company, Perth Amboy, N. J., have an exhibit of fireproofing and clay conduits, as described in our columns in a previous issue.

Hawthorne & Sheble, 604 Chestnut street, Philadelphia, Pa., show the Burton electric welding water forge in actual operation.

Otis Electric Company, New York City, are represented by Stokes & Parrish Elevator Company, 702 Bullitt Building, Philadelphia, Pa., with a small elevator with automatic push button operating device in operation.

Rudolph M. Hunter, 926 Walnut street, Philadelphia, Pa., has an exhibit showing the position of Mr. Hunter's inventions in the field of electrical progress. It includes: A third-rail electric railway system, 1-20th full size, showing Mr. Hunter's improvements with special reference to train regulation and motor trucks. Series multiple car controller, showing Mr. Hunter's development and early work. A small working model exhibits how the controller operates. The modern electric car truck with the motors hinged to axles, etc., now employed to the exclusion of all other methods. Exhibited by working models. One of Mr. Hunter's early trolleys and the first of its class. A large searchlight of special design, said to be the largest made in this country. A searchlight having horizontal carbons and reflector, invented in 1881. A projector adapted to searchlight purposes, or for stereopticon and moving photographic effects. A method of regulation without resistances. A miniature alternating transformer system illustrating methods of operation in large plants for local and long distance transmission, such as in use at Niagara Falls. Electric switches and meters. A series of volumes showing Mr. Hunter's inventions; a number of photographs showing original and later constructions under Mr. Hunter's inventions, and publications of Mr. Hunter in 1882-3-4 relating to electric railways, lighting, telephony, etc.

Vallee Bros. & Co., 625 Arch street, Philadelphia, Pa., show electrical heating apparatus, sad, laundry and soldering irons, Whitney Electric Co. volt and ammeters, Zimdars & Hunt panel feeder boards and knife switches, Victor lamps, miniature lamps, Paragon desk fans and Diehl ceiling fans. The booth is very tastefully arranged and beautifully illuminated.

The International Correspondence Schools, Scranton, Pa., are represented by Mr. E. B. Duncan, the manager, who explains the system of instruction.

General Electric Company, Schenectady, N. Y., show Thomson electric meters for two and three-wire systems direct and alternating currents, Thomson-Houston alternating fans and arc lights.

American Electric Meter Company, Ninth and Montgomery avenue, Philadelphia, Pa., show three 40 ampere three-wire meters, direct current in series; three 20 ampere, three-wire meters, direct current in series, and three 10 ampere, three-wire meters, direct current in series and lamp bank for same. A giant electromagnet and apparatus for testing the strength of the same by means of armatures. Filings spread on glass surfaces and cases for showing the formation of magnetic fields. Demonstrations are made hourly throughout the day.

Sawyer Electrical Company, Sawyer Building, 1308 Arch street, Philadelphia, Pa., show the Nowotny enclosed arc lamps; Faries lamp fixtures; a Triumph Electric Co. 7½ h. p. motor, and Sawyer elevator door locking devices, telephones, etc.

W. P. Dallett, 49 North Seventh street, Philadelphia, Pa., shows a Deming electric pump operated by an Excelsior motor.

H. R. Worthington, 724 Arch street, Philadelphia, Pa., have in operation a 250-gallon per hour house tank pump and a 500-gallon per hour duplex steeple power pump, direct connected to a Crocker-Wheeler motor, pumping the water used for the electric fountain and cataract. There is also shown a 1,000-gallon per hour house pump, direct connected to a General Electric motor.

Stokes & Parrish Elevator Company, 702 Bullitt Building, Philadelphia, Pa., have a working model of electric-hydraulic elevator, designed and constructed by D. W. C. Suplee, Glenolden, Pa.

Helios Electric Company, 1229 Callowhill street, Philadelphia, Pa., make an exhibition of enclosed arc lamps of great variety of design for indoor and outdoor service. Novel and beautiful designs of covers are shown, which have attracted as much attention as the noiseless burning of the lamps. They are distributing a very ingenious folding circular, showing their various styles of lamps and the manner of manipulating them.

Hawthorne & Sheble, 604 Chestnut street, Philadelphia, Pa., show a great variety of phonographs, kinematographs and give recitations of phonographic speeches by public men, with hourly kinematograph entertainments to large and appreciative audiences.

Barrett & Plowman, 1312 Filbert street, Philadelphia, Pa., Eastern agents, have on exhibition the Climax steam joint clamp, which possesses many decided advantages and seems to fulfil the long-felt want for a device to repair leaks on steam joints without pulling out the pipes or shutting down the plant.

PERSONAL

COL. C. E. McCLUER, so long general manager of the Southern Bell Telephone Company in a district comprising some twenty-four exchanges in and connected with Richmond, has become general manager of the independent Richmond Telephone Company, the appointment taking effect July 1.

MR. T. AHEARN, of Ottawa, Can., has just returned home from his second trip around the world with his family. He had the pleasure of seeing the American fleet at Hong Kong not long before it sailed for Manila. He says that the American flag is welcomed in the far East, and that Britishers are enthusiastic for it.

MR. J. GEORGE KAELBER, of Rochester, was a visitor to New York last week. He had closed up many of his electrical interests some time ago, but could not resist the pressure of friends and is now engaged again in engineering a number of important deals with wonted energy and success.

ELECTRIC LIGHTING

Discussion of the Papers on Alternating and Direct Current Distribution by Messrs. H. A. Wagner and L. A. Ferguson.[1]

PRESIDENT INSULL in the chair.

Prof. Fujioka, an honorary member of the association, being called upon to speak, gave a short description of the plants and system which were carried out under his direct supervision in Japan. He advocated the use of the Edison three-wire system for the more densely populated districts, but had added single and three-phase apparatus to supply current to outlying districts. Coal, he stated, costs $5 to $6 a ton in Japan.

Mr. Wagner, in answer to questions by Mr. Thayer, stated that the effect of transformer dropping is eliminated by making the transformer practically an integral part of the feeder. The transformers of very close regulation, one per cent. or under, are connected in multiple with two or three hundred feet of mains or more in between. In answer to Mr. van Trump as to the objection to cutting the feeder transformer off the line automatically and saving the under load losses, Mr. Wagner said that the object is to make the underload losses so small that it will not be necessary to do that, as it would complicate the system considerably. In the system described in the paper the highest efficiency is at the average load, so that if a transformer was cut out and its feeder was cut out, it would decrease the average efficiency rather than raise it, as it would increase the load on the other feeders, increase the copper losses in the other feeders and other transformers, and that increase in copper loss would be greater than the iron losses which you sustain temporarily. The object is to design a system to be most efficient at the average load. With a transformer that can be accomplished successfully and the wattless current is inappreciable. The volt amperes and the watts correspond so nearly in any alternating station at full load that the increase is almost inappreciable, even in the most poorly designed station. The power factor is very high at maximum loads, and with a system of this kind the power factor should be practically 100 per cent. at all times, except for alternating motors, which lower it slightly. The part of the load that comes on the peak is principally incandescent lighting. The motor load is almost constant and the arc lighting load is much more nearly constant than the incandescent load.

Mr. Dow expressed the opinion that the feeder loss of 24 per cent. given by Mr. Wagner was exceptionally high and that 12 to 15 per cent. would be nearer right. He also stated that the initial cost of transformers in alternating current systems will pay for a great deal of copper in the direct current installations. He firmly believed in the importance of a central station being able to supply current for elevator work, and that the failure to give good elevator service will often cause the establishment of isolated plants. In his opinion the alternating current service can be wonderfully improved above its customary standard, but in the case of a densely populated district demanding the greater portion of the total supply the direct current is unquestionably the best; a less densely populated section might be supplied by the alternating system, or it can be supplied, as Mr. Ferguson had suggested, by an alternating distribution and direct current.

Mr. Ferguson in answer to a question by Mr. Wilmerding stated that the 22.8 per cent. mentioned in his paper included the total losses from the station to the customer's meter, including all the trunk line losses and the main.

Prof. Goldborough thought that the low load efficiency of a plant could be increased by improving the efficiency of the transformers. He suggested the establishment of sub-stations wherein a number of transformers could be placed together and feeders be run from the central station to the sub-station, and some of the transformers could be cut out and some of the feeders could be used in common with some of the transformers. By cutting out some of the large transformers and having a few of them fully loaded instead of many of them partially loaded, the power factor of the whole distributing system would be improved. The cutting in and out of the transformers might be accomplished by means of an electro-magnetic device operated from the central station. A system similar to this, he stated, was in use in England and on the Continent, but it does not work very satisfactorily. He said in regard to arc lamps that the efficiency of the alternating current lamp as a whole is much less than the direct current lamp and it takes more power. He denied the assertion that the Welsbach light is becoming more popular than the incandescent lamp, and claimed that it was not at all suitable for interior lighting, as it makes everything look ghastly. He advocated the use of the single-phase rather than the three-phase alternating system, as with the former closer regulation can be obtained.

Mr. Rice, in answer to Mr. Scovil, stated that at Salt Lake City current is successfully transmitted over a distance of nearly fifteen miles by a three-phase four-wire system, and the same system is in use at Sacramento over a distance of twenty miles. Mr. Rice expressed the belief that the alternating current systems of light and power distribution have a great future before them, and that the alternating current motors and arc lamps will undoubtedly be further developed within the next few years.

Mr. Pillsbury: I wish to say a few words in regard to the alternating current motor, having been identified for several years with the development more especially of single-phase machines. The question has been raised as to their power factor by one gentleman, as to their practical success by another, and as to their adaptability for the direct driving of elevators by several. Single-phase alternating current motors are now made equal, if not superior to direct current motors for general power distribution. The power factor in a well designed machine may be considerably above 90 per cent. from 50 per cent. to 150 per cent. of its rated capacity, and above 80 per cent. while the motor is developing 20 per cent. of its rated output. For general power distribution these are superior to direct current motors in point of care and attendance required, average efficiency, absence of wear, etc. To the direct driving of elevators they have not as yet been applied, but there is no reason why they cannot be adapted to this work as soon as a sufficient demand shall have arisen. The only problem met with in their application to this class of service is that of starting. There are two methods of doing this, one by splitting the phase and another by introducing a commutator. Either of these is entirely successful. It may be confidently affirmed that single-phase alternating current motors are now on the market superior to direct machines for general power distribution, and that in the near future they will be adapted to such special work as the direct driving of elevators with entire success.

Mr. Insull in a characteristic and able discussion championed the cause of the reliable and well-tried direct current system of distribution. He pointed out as a main advantage of the latter the permanency and flexibility of the system and the dependence of the choice of a system on the conditions which present themselves. He gave a splendid retrospective view of the central station industry, and stated that the house-to-house plan of alternating current distribution now in use at Chicago is not satisfactory, and the losses are enormous. He defended the "beams of copper" referred to by Mr. Wagner by saying that the size of the copper bars depended on the cost of fuel. In refuting Mr. Wagner's closing claims Mr. Insull thought that the question as to the relative cost of distribution and operation with the two systems was still an open one. As to the best regulation, he believed, that the charts exhibited by Mr. Ferguson showed a regulation as nearly perfect as could be desired. Regarding the largest territory desired and readily supplied from one station, he believed it to be simply a matter of conditions. No system, Mr. Insull said, could be more flexible than the Edison three-wire system operating during the whole of the 24 hours first from one station, then from two, then from three, carrying at the same time during the 24 hours current 13,000 feet from the point of generation with a loss so small as to be almost impossible to figure out.

In conclusion he warned his listeners to go very carefully, certainly in the large cities, about adopting a scheme over one that had received the test of time. So far as widely distributed areas are concerned, Mr. Insull said, there is no doubt that the alternating current is of great advantage, but in big centres of distribution the experience of electrical engineers the world over has shown that the one system to use, one by which we

[1]Papers read before the N. E. L. Assn., Chicago, June, 1898. Printed in The Elec. Engr., June 16, 1898.

can make money and which will enable us to keep our position, is the low tension Edison system.

Mr. Ayer spoke of the advisability of leading the discussion into a channel where the small central station man would be benefited as well as those in charge of large central station interests. He believed that house-to-house distribution is doomed, which means going to the three-wire system. Also that printing presses are very troublesome to the alternating current motor man. There is no question, he said, that single-phase motors will come and be satisfactory, but they are not comparable to the direct current motor to-day. He referred to the easy destruction of translating devices and the expense connected with replacing them, and in conclusion said: "I want to express my conviction very firmly that the old system is the best one.'

Mr. Stetson, in answer to a question by Mr. Davis, gave a brief description of a station using both the direct and alternating systems of distribution. He believed it to be a good combination, especially when a station once built and equipped with direct current apparatus wishes to supply outlying districts. In such a case recourse must be had to alternating current distribution.

Mr. Ferguson replied to several questions regarding the figures in his paper representing average voltage and the natural drop in the lines under normal conditions, which he said was 11.2 or 8.8 per cent. and the efficiency of the system of distribution was 97.3 per cent.

Mr. Insull explained this heavy drop by referring to the peculiar local conditions which the Chicago Edison Co. had to contend with. The station is now very profitably located, no carting of coal being necessary and the water for condensing and feed purposes being obtained free. It simply resolves itself into a question of balancing fuel cost against interest cost and labor.

Mr. Hubeley gave some interesting converter loss figures and stated that the all important question with the alternating station is the fact that as yet no converters without these losses have been manufactured.

Mr. Thayer presented some valuable experience with the remodeling of a transformer distribution. He reached the conclusion that it is a simple matter to adapt the Edison system of distribution to fit alternating current conditions and that there is no question as to the advisability of using large transformers both in cutting down the iron losses and in improving the regulation of the plant.

Mr. Chandler represented a station which is now running three systems, this being deemed advisable on account of inherited machinery and existing local conditions. The large transformers appeared to him to be the most economical and elastic, and by putting in the district transformers the entire system is elastic and satisfactory in every way.

Mr. Walbank drew attention to a very successful three-phase lighting plant supplying over 30,000 lights. Motors are also supplied by this system, and there is no trouble from regulation; this being done by means of rheostats. Direct currents take care of the elevator demand and everyone seems perfectly satisfied with this three-phase distribution for light and power.

Mr. Ferguson in summing up the matter for the direct current advocates stated that in his opinion the question of efficiency and percentages meant a great deal as was evidenced by the results in the new station at Chicago, where these figures were lower than in the old station, but where the cost of producing a unit of electricity, with the poor efficiency of distribution, is infinitely less. The real thing, therefore, is not the curve of efficiency, but the actual cost of the production of the unit of electricity. He refuted the argument as to the expense of copper for direct current distribution by stating that the copper only represents 20 per cent. of the underground equipment and that if there is any extra expense for copper this is easily overbalanced by the cost of the transformers in the other system. In conclusion Mr. Ferguson made the following reconciliatory statement: "It is a question whether it is fair at the present time to compare the two systems, of which one has been in use for a long time, the figures relating to which are reliable, and the other being rapidly put into practice, and the figures relating to which are in the embryonic state."

Mr. Wagner then finally took the stand and replied ably to his critics and questioners. Regarding the additional resistance in the mains where alternating current is used, he stated, that on conductors as large as 300,000 c. m., which are as large as are generally used for distributing mains, the difference between the alternating current and the direct current is inappreciable. With numerous tests on that size conductor, he found that the difference in drop with a given current, with a power factor of 100 per cent., is about 10 per cent. The actual drop is increased 1 per cent. with the alternating current. With a power factor as low as 75 per cent., which is as low as any combination of power and light would be on such a system, it is increased to 3 per cent. additionally. The 2 per cent. drop of the direct current would be increased to 2.3 per cent. The additional cost for alternating mains, three-wire system, would be practically nothing. He spoke of the noiseless operation of specially designed alternating current arc lamps, 100 of which are in constant operation in St. Louis, and mentioned the satisfactory installation of six to eight elevators using two-phase alternating current motors. Replying to Prof. Goldborough's suggestion as to sub-stations and the cutting out and in of transformers, Mr. Wagner believed that with a distribution efficiency of slightly over 96 per cent. on the average load it would seem inadvisable to go to this extra expense. Then the use of sub-stations complicates the system and simplicity, without great cost of operation, merits serious consideration. He also believed that the series arc lamp for commercial lighting would soon be a thing of the past. He commented at some length on the advisability of moving a central station to one side of the district to be lighted and reaching out into new districts by employing rotary transformers conveying current to a distant high potential alternating current transformer and retransforming it to a low potential, and through rotary transformers to direct current. Such a system is in use in Brooklyn by the Brooklyn Edison Co. (described in The Electrical Engineer January 6, 1898). This fact and the one that the Chicago Edison Co. is preparing to do likewise showed the economy in this method of distribution. Mr. Wagner, however, expressed the opinion that it is undesirable to mix systems of distribution as the multiplication of machinery and the additional investment for the reserve is a very serious factor. In answer to Mr. Walbank he said that where lighting is the principal factor, the three-phase distribution cannot be made to regulate as well and give as satisfactory results as the single-phase or direct current.

Series Arc Lamps on a Railway Circuit.

The following remarkable and unique incident has recently been reported from Kansas City, Mo. On Saturday, May 14, Kansas City was visited by a hailstorm the like of which has never been equaled in the memory of the oldest inhabitants. The ground was covered with hailstones, the smallest being about the size of moth balls, and ranging from that size to two and one-half pounds, and somewhat larger than door knobs. As can be imagined, the electrical wires suffered materially. At about 10:30 on Sunday morning the station manager at the plant of the Kansas City Electric Light and Power Company was surprised to receive a telephonic inquiry of "Why don't you shut down your arc circuit?" An investigation showed that three arc circuits had become crossed on the trolley and that thirty arc lights had been burning since 5:30 a. m. As it happened, the lamps got the current "upside down," and the result was thirty beautiful examples of the heating effect of the electric arc and thirty lamp bases molten into as many lumps of brass. We are indebted to Mr. J. L. Morgan, the city electrician of Kansas City, for the above interesting details.

CORUNNA, MICH. Messrs. G. B. Clarke and C. M. Holley have put in operation the new Corunna Electric Lighting Company's plant, with a paid in capital of $4,000. It is a direct current system with Card generator of 50 k. w., driven by an Armington & Sims engine of 75 h. p., with an Atlas boiler of 100 h. p. The concern will be glad to receive estimates and information in regard to electrical equipments for coal mines, etc.

ELECTRIC HEADLIGHTS. It is reported by the Railroad Gazette that about 200 electric headlights are in use on eight roads, chiefly for passenger traffic, and with very satisfactory results over oil.

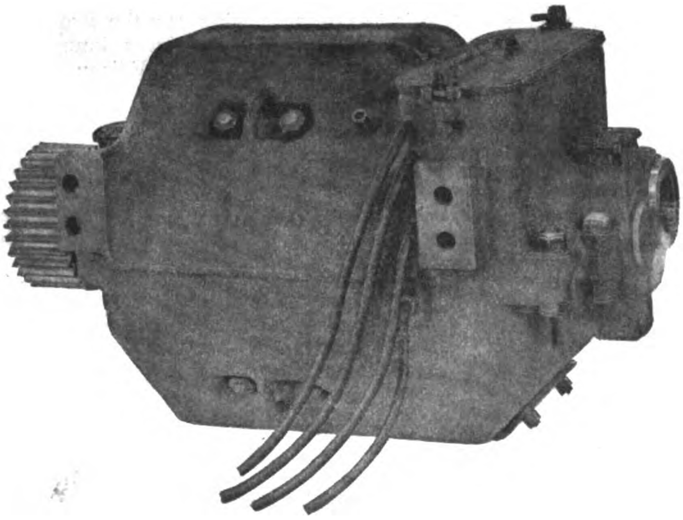
A FIELD TELEGRAPH TRAIN with capacity for sixty miles of line, is reported as part of the equipment of the troops who left Tampa for Santiago de Cuba.

ELECTRIC TRANSPORTATION

New General Electric Railway Motor.

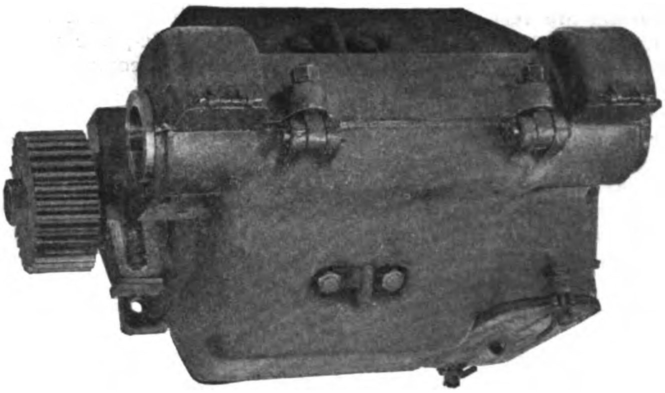
THE General Electric Company announces the development of a railway motor especially adapted for medium heavy railway work, under the designation of the G. E. 51-B. It is the outcome of a series of exhaustive tests on cars and locomotives with heavy trains propelled by electric motors on steam train schedules and the complete and reliable data thus obtained has been used to determine the best form of construction necessary to meet the requirements. This motor has been especially designed for high speed suburban and elevated railway work. It has a capacity of 80 h. p. based on a rating of 75 degs. C. rise in temperature of the windings above that of the surrounding atmosphere after one hour's run at rated load. A double G. E. 51-B motor equipment, with the gear ratio of 2.27 will propel a loaded 20-ton car at a maximum speed of 26 miles per hour on a level track. Higher or lower gear ratios may be used for different speeds; that is, with the speed reduced one-half, the motors will handle a car or train twice the weight.

The frame of the G. E. 51-B is of cast steel, made in two bowl-shaped halves bolted together. It completely protects the working parts of the motor from mechanical injury and the action of water or dust. The upper casting has a large opening to allow of the inspection of the commutator and brush holders, and the replacement of the brushes. This is covered with a dust-proof cover plate easily removed by turning a cam-locking device. A hand hole, also fitted with a weather-proof cover plate, let into the lower frame at the commutator end, facilitates the removal of any foreign substance in the bottom of the motor.



G. E. 51-B RAILWAY MOTOR, FRONT END.

The motor has four laminated pole-pieces with projections supporting the coils which are slipped over them. They are secured by bolts passing through the frame and fastened with nuts on the outside. The bearings have been given ample proportions to insure good lubrication and long life. The upper support of the linings of the armature bearing is part of the upper half of the motor frame; the lower support is a cap bolted to the upper support. The armature can thus be held in the upper half of the motor, while the lower half only is lowered. To remove the armature it may be lowered with the lower half. The cored recess between the inner ends of the lining and the motor frame is occupied by a combination thrust collar and oiled guard, an open space at the bottom being left to give free outlet to oil or grease. With this construction it is impossible for oil or grease to work its way into the motor or come into contact with the windings. The upper supports of the linings are provided with large grease boxes, and the lower are cored, leaving a recess for the oil. Felt wicks or wipers come in contact with the shaft through openings in the lining, and convey a continuous supply of oil to it. The linings of the armature bearings are cylindrical in form, made of cast iron and babbitted, and are held in place by dowels in the lower support. The axle bearing linings are held in place by the upper and lower halves of the frame, extending back and enveloping the car axle. They are made of composite bearing metal lubricated by oily waste held in an oil well and pressed against the outside of the axle by a leaf spring. The dimensions of the armature bearing are—commutator end, 6¾ by 3 inches; pinion end, 9½ inches by 3¼ inches. The axle bearings are 9 inches long with diameter corresponding to the size of the axle.

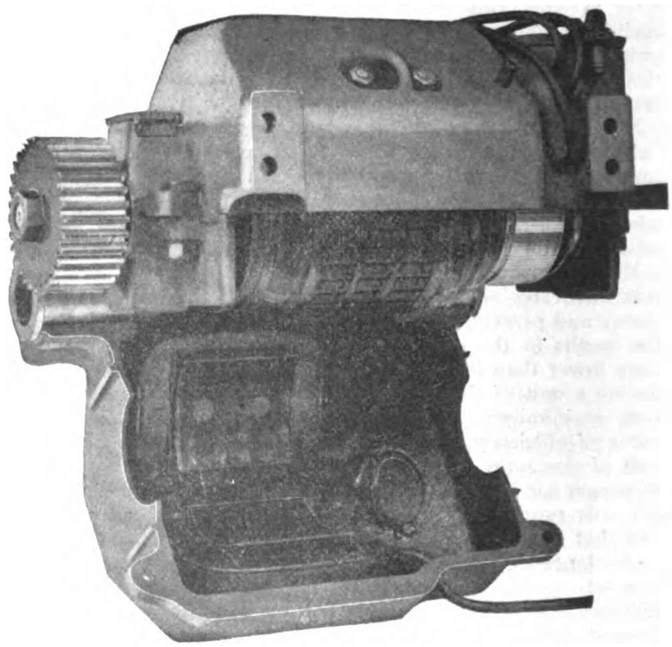


G. E. 51-B RAILWAY MOTOR, REAR END.

The field coils are of copper ribbon wound on metal spools and insulated between turns with asbestos. The coils are thoroughly insulated from spools with specially prepared mica, canvas cloth and press board. After the windings are in place, the canvas is brought over and sewed, completely enclosing and protecting the coil. The whole is then given a heavy coating of weather-proof insulating compound.

For convenience in car wiring and to facilitate opening of the motors, the connections between the upper and lower fields are made on the outside of the motor and both field and armature leads are brought out at the front.

The armature is of the iron-clad, hollow core type, 16 inches in diameter and 10½ inches long. The core is built up of well annealed laminations provided with ventilating ducts, as in the armature of the G. E. railway generators, the laminations being assembled directly on the shaft and not on a separate spider. The core has 37 slots, each containing 3 insulated coils laid together in one compact unit. This gives the armature 37 sets of coils with 111 leads, corresponding to the number of bars in the commutator. All coils are formed and insulated before application to the core, the small number facilitating repairs, while the method of grouping them permits the use of substantial insulation. This is of the highest grade, and



G. E. 51-B RAILWAY MOTOR, LOWER FRAME DROPPED, ARMATURE IN POSITION.

shipment of armatures poorly insulated is prevented by giving each a thorough test with 2,500 volts alternating.

The pinion is made of cast steel with machine cut teeth, and bored for a taper fit on the armature shaft. Both gears and pinions are made at the General Electric Company's gear plant at Lynn.

The commutator is 11⅝ inches in diameter with 111 segments built up with alternating layers of mica insulation and securely clamped on a malleable iron shell. The segments are of the best hard drawn copper 6⅛ inches long, with a wearing depth of 1 inch. The mica cone insulations used in assembling the commutator are built up and compressed into molds, making them hard and compact, and the mica between the segments is especially selected with a view of giving it a degree of hardenss that will make it wear evenly with the copper segments. To insure perfect insulation every commutator is tested with 500 volts direct current between adjacent segments, and 5,000 volts alternating between the segments and the shell.

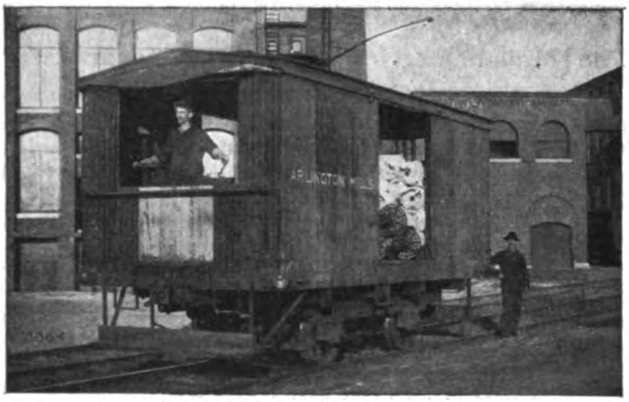
The brush holders are of cast brass and each is arranged to hold two carbon brushes which slide in finished ways and are pressed against the commutator by independent pressure fingers, giving a uniform pressure throughout the whole working length of the brushes. The brush holders are off-set ¼ inch to prevent the wearing of grooves in the commutator and are clamped to a well seasoned hardwood yoke filled with moisture-proof compound bolted to the top magnet frame and easily removable through the opening over the commutator. Mounted on 33-inch wheels, the clearance between the bottom of the frame and rails is 3 inches. That between the bottom of the gear case and rail is 4 inches.

Electric Yard Locomotive, Arlington Mills, Mass.

A STRIKING instance of economy in actual money and elimination of trouble and delay induced by supplanting a steam haulage service with electric traction is afforded by the installation recently made by the General Electric Company for the Arlington Mills, Lawrence, Mass. These mills have about two miles of track running from the main line of the Boston and Maine Railroad into the yards and throwing off spurs into the alleys between the different buildings. Previous to the change to electrical service, the haulage of the entire output of the mills to the main line, the haulage of the material from building to building, as well as the necessary switching about the yards, was done by a steam locomotive rented from the railroad. For this service the Arlington which they took into serious consideration. As every case, in which electric traction has been adopted in factories, showed an improved service, as well as an actual money economy, electricity as a motive power was decided upon.

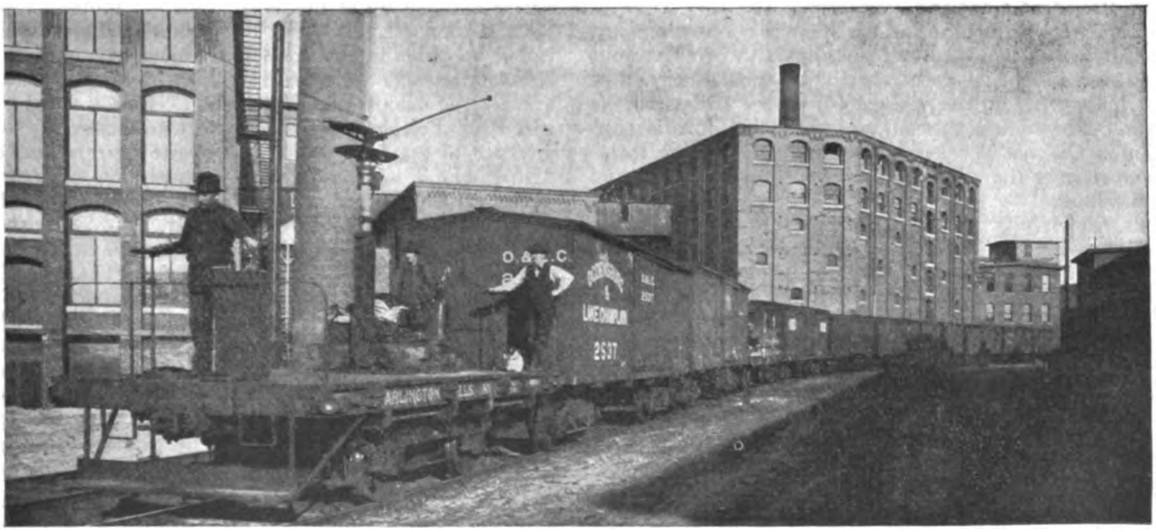
The electrical installation consists of a small generating plant and two electric locomotives, one of the box type and the other a platform car. The generating plant consists of a standard G. E. 75 k. w., 500 volt railway generator driven by belt from an Armington and Sims high speed engine. The generator readily answers all calls upon it, with absolutely no heating or sparking, although it is occasionally subjected to very heavy overloads when both cars are handling a train of more than the usual number of loaded cars.

The box car locomotive used for hauling material about the



GENERAL ELECTRIC BOX CAR LOCOMOTIVE, ARLINGTON MILLS.

yards is equipped with two G. E. 800-27 h. p. motors and series parallel controllers. The platform locomotive is used to haul trains of loaded cars from the yards to the main line, and empties from the line to the mill tracks, and to do all the drilling in the yards. The equipment of this locomotive consists of two 50 h. p. G. E. 1,200 motors with the necessary series parallel controllers. In hauling heavy trains it is assisted by the box car locomotive. Together they are able to handle trains of 30 to 40 empties, or 12 to 14 loaded cars, with comparative ease and celerity. To give the necessary adhesion to the more powerful locomotive to



G. E. PLATFORM LOCOMOTIVE HAULING A TRAIN, ARLINGTON MILLS.

Mills paid an annual rental of several thousand dollars, and were, moreover, frequently put to great inconvenience and delay on account of the unavailability at times of any locomotive.

The successful results obtained with electric factory locomotives by other mills, in New England, notably at Whitinsville, Mass., and Taftville, Conn., attracted the attention of the managers of the Arlington Mills to the question of electric haulage

enable it to handle heavy loads, about six tons extra is placed on the platform.

Perhaps the most interesting feature is the comparison between the cost of the electric plant and the expense formerly entailed by the use of the superseded steam locomotive. The cost of the entire electric plant was very little in excess of one year's rental of the steam locomotive. No more men are employed

about the electric locomotive, the labor cost has not risen and the consumption of coal is scarcely felt on the main plant. Furthermore, the plant being always ready, cars may be shifted at any time during the day or night.

The new system is thus both economical and advantageous, and the appreciation of the Arlington Mills is, perhaps, best shown by the fact that a second platform locomotive is shortly to be added to this haulage plant.

Society & Club Notes

The Midsummer Meeting of the Northwestern Electrical Association.

THE starting of the "Northwest" from Chicago for Milwaukee and other lake ports, for the midsummer convention of the Northwestern Electrical Association was noted in The Electrical Engineer last week.

After leaving Milwaukee on Friday a direct route was taken for Mackinac Island, which it was hoped would be reached in time to allow of a drive. But during the night a heavy fog arose which compelled slowing down, and as a consequence the island was not reached until 1 o'clock on Saturday, and a stop of only fifteen minutes was made there. The sail through the Mackinaw Straits was greatly enjoyed by all.

At about 8:30 p. m. Sault Ste. Marie was reached. A tug bearing the Reception Committee met the "Northwest," and amid a great blowing of whistles the big ship stopped at the entrance to the long St. Mary's lock on the American side. Under the guidance of the Reception Committee and citizens, the Association was escorted beneath a triumphal arch erected in honor of the visitors and bearing the motto, "Welcome" in incandescent lamps. Thence the way was led to the New Iroquois Hotel, where in the large hall the Association was formally welcomed by Mayor Kelleher.

Mr. Francis H. Clergue, vice-president of the Lake Superior Power Co., then delivered a most instructive address on the growing industries and the prospects of Sault Ste. Marie. Various other local speakers followed.

Prof. I. Fujioka, of Tokio, Japan, also addressed the assembly, as did Dr. Elisha Gray, and the Association's thanks were expressed by President Copeland.

The members were up bright and early on the following day, Sunday, and in carriages placed at their disposal visited various points of interest. The first point visited was Fort Brady, now all but deserted, owing to the withdrawal of the troops to the scene of war. Descending the hill on which the fort is situated, the Union Carbide Works were visited. There the members were shown over the works by Mr. W. R. Kenan, Jr., and Mr. H. Von Schon.

The works, which are only temporary, contain four carbide furnaces designed by Mr. W. S. Horry. These are of the continuous type and produce about four tons of carbide per day of twenty-four hours. The furnace consists of an iron cylinder or drum, into which the mixture of powdered coke and lime is shoveled, and into which the carbon electrodes are inserted, the iron drum forming the other electrode. As the carbide is formed the drum is slowly revolved, and new charges are added. The finished carbide drops out at the other end. These furnaces operate continuously and produce about 9 pounds of high grade carbide per day per electrical h. p. We understand that the Horry carbide furnaces will shortly be introduced at the Niagara Carbide works, the two companies having recently been consolidated. At the present time only 2,000 h. p. is being employed in making carbide at Sault Ste. Marie, but this will be shortly increased to 20,000 h. p. in the new works to be erected near the present ones. The power is now transmitted across from the Canadian side, but in connection with the new works the water power will be developed on the American side and the generators direct connected to the water wheels at the new carbide works.

Crossing the Sault the visitors inspected the new Canadian canal and locks operated by electric motors, as well as the adjoining pulp mills owned by the Lake Superior Power Co., the party being under the guidance of the genial Mr. Francis H. Clergue, vice-president of the company. After passing through the mills the party repaired to the "Block House," Mr. Clergue's residence. This is a relic of the old trading post days, but has been transformed, in its internal arrangements, into magnificent bachelor apartments. The party was regaled with a sumptuous lunch, Mr. Clergue making a most charming host. It was no wonder that the company long overstayed the allotted time, and did not get back to the "Northwest" until after two o'clock. After cheers for Mr. Clergue and the "Soo," the steamer pointed its nose toward Houghton, Mich. In the evening a concert was given on board in which the members of the party contributed vocal and instrumental music and recitations.

Every one was up at 6 on Monday morning, the ship having arrived at Hancock, Mich. At 7:30 a special train took the party to the crushers and smelters of the Calumet and Hecla and Tamarack copper mines. All the departments of these admirable establishments were visited under the guidance of the officers and staff of the company, and Mr. James R. Dee, of the Houghton Electric Light Co. Here the visitors stocked themselves with many beautiful specimens of copper ore.

Boarding the train again, the party was taken up to the Calumet mines, about five miles distant. Here the various shaft and compressor houses were visited containing the magnificent hoisting engines, designed by Mr. E. D. Leavitt, Jr., whose great pumping engines at the crushers below had been previously inspected. A sumptuous lunch was then partaken of at the Calumet armory and after visiting some other points of interest the party returned by train, after passing a hearty vote to the Calumet & Hecla Company. As the party boarded ship each one was presented with a souvenir in the shape of a miniature copper ingot.

At 4 p. m. the lines were cast off and, after passing through the Portage Canal, the "Northwest" headed directly for Duluth.

In the evening the Association met in the ladies' saloon and listened to the papers of Mr. A. J. Wurts on "Lightning Arresters," Mr. Snow on "Forced Draft" and Mr. Dow on the "Purification of Boiler Water."

The members were pretty well tired out by this time, but, welcome though rest would have been, it was willingly postponed in order to witness a magnificent display of the aurora borealis, which many watched for a long time.

Tuesday morning found the party at Duluth. Disembarking from the "Northwest," the party took boat for West Superior and put up at the West Superior Hotel. After breakfast electric cars were taken back to Duluth, where the meeting was called to order in the council chamber at the City Hall. The Association was welcomed by Mayor Triaelson.

After the discussions, President Copeland called on Dr. Gray and Prof. Fujioka, who made short addresses.

Votes of thanks were passed to the officers and crew of the "Northwest," who had done so much for the comfort of the party; to the Mayor and citizens of Duluth and of Sault Ste. Marie, and last, but not least, to Mr. J. M. Hill and the members of his committee, who had arranged the trip and carried out the splendid programme provided. Too much, indeed, cannot be said of the ceaseless care and trouble which these gentlemen took to make the trip enjoyable for each individual member, in testimony of which Mr. Hill was presented with a handsome souvenir by the members of the party.

On Tuesday afternoon the citizens of Duluth tendered to the Association a drive about the city and over the splendid boulevard, giving an excellent opportunity of noting the substantial character of the town and the beauty of its surroundings. Later the party was given a boat ride, which afforded another opportunity of studying the shipping facilities of the "Zenith City of the Unsalted Seas."

In the evening a banquet was given at the West Superior Hotel, tendered by the citizens of West Superior. This active city, lying just across the bay from Duluth, is a most prosperous community and is destined to share with its sister city in the undoubted great future progress.

Altogether the midsummer excursion meeting of the Northwestern Electrical Association was most happily conceived and carried out from beginning to end. There was not the slightest mishap to mar the pleasure of the trip, and the good-fellowship

met with on every hand gave the whole affair the character of a family gathering with all that this implies. It is safe to say that the recollection of the trip will never fade from the memory of those who participated in it. We can only say that we are sorry for those who missed it.

The Independent Telephone Association of the U. S. A.

The annual meeting of The Independent Telephone Association of the United States of America will be held at the Palmer House, Chicago, June 30 and July 1 and 2. The meeting will be simply a business meeting of the members, but anyone interested in independent telephony can obtain membership at the meeting and be entitled to admission to the sessions. The press will be furnished such information as can be made public by a committee appointed for that purpose.

American Institute of Electrical Engineers.

The Institute will hold its fifteenth general meeting at the Millard Hotel, Omaha, Neb., beginning Monday, June 27, at 10 a. m., with daily sessions until Thursday. President Kennelly will deliver an inaugural address, and some sixteen papers will be read. The exposition will be one of the features of the meeting, which should draw out a good attendance of Western members.

Railway Telegraph Superintendents.

The National Association of Railway Telegraph Superintendents met at Omaha on June 15 and elected the following officers: President, W. W. Ryder, of the Chicago, Burlington & Quincy, Chicago; vice-president, L. B. Foley, of the Delaware, Lackawanna & Western, New York; secretary and treasurer, P. W. Drew, of the Wisconsin Central, Milwaukee.

A Creditable Canadian Electrical Journal.

Apropos of the eighth annual convention of the Canadian Electrical Association, to be held in Montreal on the 28th, 29th and 30th inst., the publisher of the Canadian Electrical News of Toronto has issued a specially interesting number for June, the contents of which serve to illustrate the rapid development of electricity in Canada. Besides the electrical features of Montreal (including portraits of the local committee of the Electrical Association convention), other articles worthy of mention are: "The Mooteu Wireless Telegraphs," by D. H. Keely, superintendent Dominion telegraph system; "The Cataract Power Company's Works," in course of construction (illustrated); description of C. P. R. copper wire from Montreal to Vancouver, B. C., with portraits of officials and superintendents of construction; map showing long-distance lines and offices of the Bell Telephone Company. Altogether, it is a valuable number for those engaged in electrical pursuits.

THE N. A. OF S. E. of Greater New York, has opened a bureau of employment for members of the association at room 39, Bible House, Third avenue and Twenty-eighth street. It is in charge of Mr. J. H. Monckton, as manager. The bureau will be glad at any time to furnish reliable men for stationary engineers' positions.

MARRIED

Gill—Stewart.

William B. Gill, well known as the superintendent of the Philadelphia division of the Western Union Telegraph Company, was married recently to Miss Helen Stewart at the residence of the bride's mother in that city. The wedding was a very quiet one, only the immediate family being present. The ceremony was performed by Rev. Joseph Wilson Cochran, of the Northminster Presbyterian Church. Immediately after the ceremony Mr. and Mrs. Gill left for a wedding trip. Upon their return they will reside at Mr. Gill's country house at Cheltenham.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued June 14, 1898.

Alarms and Signals:—

LETTER BOX. M. J. Wine and C. A. Thompson, Washington, D. C., 605,592. Filed April 17, 1897. Provides an indicator situated at a point convenient to the carrier to indicate whether there is any mail in the box.

SELECTOR SIGNALING SYSTEM. T. C. Drake, Malta, Ohio, 605,688. Filed Sept. 17, 1897. Details of construction.

AUTOMATIC ELECTRIC FIRE ALARM. H. A. Olsson, Quincy, Mass., 605,795. Filed June 17, 1897. Constructed to automatically sound an alarm to indicate in which of the rooms of the house the fire is started.

ELECTRIC RAILWAY SIGNAL. C. L. Renrew, East Windsor, Conn., 605,798. Filed March 2, 1897. Designed to warn the engineer upon one railway vehicle of the presence of another vehicle or obstruction upon the same track.

Batteries, Secondary:—

SECONDARY BATTERY. C. Brault, Paris, France, 605,695. Filed Dec. 28, 1896. Comprises a body of active material, an enclosing fabric of asbestos, an outer covering of perforated neutral material and cross rods, lying in openings in the active material, their ends being connected to the neutral plates by a solvent of the material of which the plates are composed.

Conductors, Conduits and Insulators:—

STRAIN INSULATOR. L. McCarthy, Boston, Mass., 605,741. Filed Jan. 18, 1898. Comprises metallic portions separated from each other by interposed insulating material, a case having inwardly projecting flange, a sleeve and bolt.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. C. P. Steinmetz, Schenectady, N. Y., 605,525. Filed Jan. 28, 1895. Comprises a dynamo electric machine, having out-of-phase coils connected to three collector rings, and the remaining terminal of one coil connected to an intermediate point in the second coil, and a fourth collector ring likewise connected to the intermediate point in the last named coil.

SYSTEM OF ELECTRICAL DISTRIBUTION. C. P. Steinmetz, Schenectady, N. Y., 605,526. Filed June 17, 1897. Combines a generator having a main coil, and a supplemental coil at an angle thereto connected at one end to an intermediate point in the main coil, with a three-wire distributing system fed from the main coil, and a multiphase translating device from both coils.

Electro-Metallurgy:—

ORE STAMP. D. M. Smyth, Pasadena, Cal., 605,615. Filed June 9, 1897. Combines two stamps and the electromagnets for actuating the same with circuit connections and a switch that is changed by the upward movements of the stamps alternately, for energizing the magnets and raising one stamp and accelerating the fall of the other.

Electro-Therapeutics:—

ENDOSCOPIC INSTRUMENT. T. S. Pitt, Boston, Mass., 605,652. Filed June 1, 1897. A detachable light holder for use on an endoscopic instrument comprising a concavo-convex body portion for receiving the incandescent light and having an extended shank with bayonet slots for attaching it in place, and a removable sliding cover formed with upwardly-turned reflectors.

Lamps and Appurtenances:—

INCANDESCENT ELECTRIC LAMP. O. H. Michaelson, Charleston, W. Va., 605,498. Filed July 17, 1897. The globe and its base may be separated for the purpose of cleaning or replacing a broken filament.

ELECTRIC ARC LAMP. D. Higham, Boston, Mass., 605,714. Filed Oct. 26, 1897. Designed for direct-current constant-potential circuits, having two or more sets of electrodes connected in series and magnetic means for controlling the current passing, in combination with means for momentarily extinguishing the current by opening the circuit at suitably frequent intervals.

Measurement:

ELECTRIC RECORDING INSTRUMENT. C. L. Jaeger, Maywood, N. J., 605,548. Filed Aug. 7, 1897. Speed indicator and recorder.

TELEPHONE RECEIVER. P. C. Burns, Chicago, Ill., 605,594. Filed Nov. 20, 1897. Comprises a permanent magnet and its accessories, an insulating disc secured to the heel thereof, a sleeve adapted to slip over the disc, a screw threaded collar, an adjustable ring, stop screws, a diaphragm and a diaphragm cup.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 605,665. Filed Aug. 6, 1897. Comprises an annular armature, coils exterior to the armature, coils within the armature, circuit connections for energizing the outer and inner coils, a magnetic core having part of its poles enclosed by the inner coils, and closed circuits on the other poles of the core.

APPARATUS FOR SUPPLYING OR MEASURING CURRENTS OF ELECTRICITY. W. D. Watson and T. Humphreys, Rochdale, England, 605,765. Filed Dec. 28, 1897. Comprises a clock-work and its adjuncts, with mechanism for cutting off the current supply and means actuated by the key of the clock-work when applied thereto for working the cut-out.

Miscellaneous:—

ELECTRIC ELEVATOR. H. Cochrane, Chicago, Ill., 605,598. Filed April 19, 1897. A brake for elevators employing compound wound motors.

ELECTRICALLY DRIVEN AND MOVED PLOW. E. Dallmann, Neusalz, Germany, 605,631. Filed Oct. 9, 1897. Details of construction.

INSULATING ELECTRODES FOR ELECTRIC GAS LIGHTING BURNERS. A. L. Bogart, Jamaica, N. Y., 605,661. Filed May 5, 1897. Designed for use on Welsbach burners and combines one of the electrodes formed of a metal wire with an insulating shield through which the wire is threaded.

APPARATUS FOR COOLING AND PURIFYING LIQUIDS. O. W. Swift, New Haven, Conn., 605,685. Filed July 16, 1897. The liquid is sprayed and simultaneously subjected to an electric current.

Railways and Appliances:—

ELECTRIC RAILWAY. A. J. Moxham, Lorain, Ohio, 605,508. Filed Nov. 18, 1897. Embodies a bared sectional conductor in series with one side of the circuit through a current conveyor which is closed by the passing vehicle, and track rails connected to the opposite side of the circuit, contacts placed adjacently to crossing track rails and in circuit with the source of supply through a hand operating device.

ELECTRIC RAILWAY. C. H. Davis, New York, 605,663. Filed Nov. 2, 1897. The line is divided into insulated divisions, a signal device is associated with each division and constructed to exhibit a danger signal and a safety signal, and means controlled by the signal device for interrupting electrical circuit through the associated line division when the danger signal of that device is exhibited.

COMBINED TRAIN ARRESTING AND SIGNALING MECHANISM FOR ELECTRIC RAILWAYS. C. H. Davis, New York, 605,664. Filed Nov. 9, 1897. Similar to above.

MOUNTING FOR ELECTRIC MOTORS. E. B. W. Reichel and F. W. V. Stein, Berlin, Germany, 605,679. Filed Jan. 27, 1898. Consists of a spring carriage mounted upon the truck of the vehicle, a supporting rod carried by the spring carriage whereon the motors are mounted upon either side of the spring carriage, a non-rigid mounting connecting the supporting rod and motors and a supplemental connecting part uniting the motors.

TROLLEY WHEEL. A. F. Humphrey, Allegheny, Pa., 605,716. Filed Dec. 9, 1897. Employs two spring-actuated arms which extend over the trolley wheel and prevent the wheel from leaving the wire.

TROLLEY POLE. J. N. Prisk, Johnstown, Pa., 605,796. Filed Feb. 8, 1897. Means for retaining the trolley in contact with the wire either from above or below.

ELECTRIC RAILWAY SYSTEM. H. A. Chase, Boston, Mass., 605,814. Filed Feb. 7, 1891. Underground conduit system.

ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 605,824. Filed Dec. 14, 1897. Means for controlling the speed of an electric train of cars as distinguished from the control of an individual car.

Telephones:—

CARBON TRANSMITTER. G. W. Goss, Kokomo, Ind., 605,575. Filed April 20, 1897. Provides a chamber to receive the powdered carbon, and an agitating device separate from the carbon holder and arranged within the chamber for agitating the powdered carbon independently of any movement of the carbon holder.

TELEPHONE CIRCUIT AND APPARATUS. M. G. Kellogg, Chicago, Ill., 605,580. Filed March 23, 1897. Multiplex system of telephony.

AUTOMATIC APPARATUS FOR TELEPHONE SWITCHBOARDS. J. H. West, Berlin, Germany, 605,659. Filed July 8, 1896. Details of construction.

TELEPHONE SWITCHBOARD SYSTEM. F. C. Hughes, Detroit, Mich., 605,670. Filed July 3, 1897. Details of construction.

CORD WEIGHT FOR TELEPHONE SWITCHBOARDS. F. C. Hughes, Detroit, Mich., 605,671. Filed Sept. 27, 1897. Comprises a narrow confining way composed of smooth parallel plates, a thin heavy disc located in the way whose opposed faces are smooth and stand contiguous to the walls, and a cord passing around the arc of the disc in the way and supporting the disc.

TELEPHONE TRANSMITTER. W. E. Sundberg, Worcester, Mass., 605,832. Filed Sept. 28, 1897. Comprises two carbon contact plates, one of the carbon contact plates being adjustably mounted in the transmitter casing and the other contact plate being carried by a diaphragm arranged to be vibrated by the sound waves acting thereon through the ordinary mouthpiece.

REPORTS OF COMPANIES

The Proposition to Reduce General Electric Stock.

Samuel Carr, Thomas L. Livermore and Edward F. Atkins, who, in January, 1896, were appointed a committee by the holders of more than one-half of the preferred stock of the General Electric Company, have issued a circular in Boston to the preferred stockholders relative to the subject of a dividend. They say that they have on several occasions urged the declaration of a dividend on the preferred stock, but have been met with the reply that the laws of New York prohibited such action, as the value of the company's assets was less than the amount fixed as the company's capital stock, $34,712,000. The committee's circular continues, as follows:

The report of the company of January 31, 1898, shows that the profits of the business for the year were at least $1,481,852—equal to 7 per cent. of the preferred stock and nearly 3.88 per cent. of the common stock. The report also shows that the value of the stocks and bonds on hand exceeds the outstanding bonds of the company by $1,455,872, and that cash and notes and accounts receivable equal $5,963,175, as against accounts and interest payable of only $313,525.

This sound state of affairs seems to remove all ground for further withholding the earnings of the company from shareholders. To remove what directors regard as legal obstacles in the way of resuming dividend payments, it has been suggested that the nominal value of the capital stock should, by vote of shareholders be reduced so as not to exceed the value of the assets of the company; and to this end a reduction of 50 per cent. of the par value of the shares has been suggested, together with payment of the accumulated dividends on the preferred shares to date of reduction at the rate of 7 per cent. on the present par value of $100 per share.

Eminent counsel advise the directors that as a legal result of this reduction the holders of preferred shares would be entitled to dividends out of future earnings of 7 per cent. on $50 per share only, while holders of the common shares would be entitled to all the remaining earnings. This would, for the future, reduce the dividend on preferred shares one-half, while it would leave the common shareholders in a better position than their present one.

The company's assets, the circular continues, amount to at least 72 per cent. of the par value of all the shares; and for this reason the committee has declined to recommend a reduction to any amount below $72 a share. The proposition to reduce the par value of the shares to $50 is soon to be submitted to a meeting of stockholders, who can by a two-thirds vote carry it unless restrained by legal process. The committee seeks authorization to oppose this project at the meeting and in the courts, and to that end asks for the deposit of certificates of shares assigned to the American Loan and Trust Company, for which it will issue negotiable receipts.

Erie Telephone Annual Meeting.

At the annual meeting of the Erie Telegraph and Telephone Company, Charles J. Glidden in the chair, held in this city last week, the following were elected directors: Charles E. Adams, Charles J. Glidden, J. W. C. Pickering, Asa C. Russell, Levi Sprague and James H. Mills, of Lowell, Mass.; Wesley A. Gove, David S. Greenough and Charles S. Tuckerman, of Boston, Mass.; Harvey A. Whiting, of Wilton, N. H.; Henry D. W. Burt and H. Fred Stevens, of New York. Mr. Mills succeeds Abner S. Adams, of Lowell, deceased. The Board of Directors organized by the election of the following officers: President, Charles J. Glidden; secretary, George B. Perham; treasurer, Charles A. Grant; general manager, James P. McKinstry. The annual meeting of the Southwestern Telegraph and Telephone Company was held at the same place, and officers elected as above, with the exception of Messrs. Burt and Stevens, of New York, and with the addition of Thomas Sherwin, of Boston, and David B. Parker, of Buffalo, representing the American Bell interests in the company. The company now has 26,570 subscribers.

Annual Meeting of Siemens-Halske Elec. Co.

The annual meeting of the stockholders of the Siemens & Halske Electric Company of America was held on June 16 at their offices, Monadnock Block, Chicago. Nearly the entire capital of the company was represented at the meeting, and the following gentlemen were elected directors of the company: Chas. T. Yerkes, Martin Maloney, Jno. R. Bartlett, R. Suydam Grant, Chas. E. Yerkes, E. A. Moore, B. W. Grist, Howland Coit, W. L. Elkins, Jr.

The new board of directors was organized, and the following gentlemen were elected officers of the company: Chas. E. Yerkes, president; W. T. Block, secretary and treasurer; C. F. Marlow, asst. secretary and asst. treasurer; B. W. Grist, general manager. The following gentlemen compose the executive committee: Martin Maloney, Chas. E. Yerkes, J. R. Bartlett.

Consolidation of Cutler-Hammer and American Rheostat Companies.

An important combination in the rheostat business has just been consummated by the consolidation of The Cutler-Hammer Mfg. Co., of Chicago, with the American Rheostat Co., of Milwaukee, both companies being well and favorably known to the electrical trade. The business will be carried on under the name of The Cutler-Hammer Mfg. Co. at 70-80 West Jackson street, Chicago. The capital stock of the combined company has been increased to $75,000, and a large proportion of this increase has been invested in new machinery. With its increased manufacturing facilities and larger capitalization the company will be able to take care of its rapidly increasing business in a prompt and satisfactory manner. The officers of the new company are as follows: F. R. Bacon, president; F. L. Pierce, vice-president; J. G. Hickcox, secretary and treasurer; H. H. Cutler, electrical engineer and general manager.

TRADE NOTES & NOVELTIES

Manufacturers and Dealers in Electrical Supplies in Pittsburg—Notes From the Field.

BY C. B. FAIRCHILD.

THE WASHINGTON CARBON COMPANY.

AS the name implies, this firm are manufacturers and dealers in carbons for electrical purposes, including arc light pencils, generator and motor brushes, battery carbons, and large carbons for electrolytic purposes. The works are located at Washington, Pa., thirty miles from Pittsburg, and occupy a tract of about three acres, which is covered with numerous buildings of corrugated iron, usually one story in height. They are conveniently located to each other, and are thoroughly equipped with the necessary appliances for receiving the crude material and passing it through the various processes until it reaches the storage and shipping department, from which the products go to all the world, competing successfully with the reputed high grade products of the old country.

The works really consist of two factories, in which different processes are employed for forming the carbon, one known as the moulding process, the other a pressed process. The products are also graded, and the higher grades are produced from what is known as lamp black carbon, and in the making of which certain trade secrets are employed which we are not permitted to describe. While in the manufacture of the ordinary grades there are no secrets, and the biography of a carbon pencil becomes very interesting, although it grows to its marketable shape through an atmosphere laden with its own black dust and a temperature that is exceedingly trying to those who direct the operations.

The material from which carbons are made is known as coke, comes in large chunks, and is delivered by cars directly into the works. It is the residium of petroleum oil stills, and is purchased directly from oil refineries. It is a black, porous material, and has about half the specific gravity of the Connellsville coke. The material is first ground in an ordinary bark mill, to what is known as pea size, and is then elevated by belt conveyers to large storage bins on the second floor. From this it is drawn and shoveled into the calcining furnaces or retorts, which are made of fire brick. These are filled with the material and are fired by means of natural gas, the burners entering at intervals through the front wall. The door is tightly closed, so that the material burns in its own gas, and by this process all the volatile matter is consumed, and the mass settles down to about eighteen inches in thickness, being then 99 per cent. pure carbon. It is then removed while still hot in iron barrows and placed in the cooling bins, and when cool it is again elevated and ground in an ordinary burr stone mill the same as flour, and in passing from this mill, is bolted through silk cloth into four grades. Each grade is then weighed and mixed with a certain portion of pitch, known as binding material, which by itself is a product of coal tar distillation, and which has already been crushed as described for the carbon. After mixing it is placed in a closed revolving heater or mixer, in which the binding material is thoroughly incorporated with the powdered carbon at a temperature of about 200 degrees. From the mixer the material is elevated to a cooling room which is about thirty feet square, where it remains until thoroughly cool, when it is again ground, this time in a centrifugal mill, consisting of two discs set edgeways, and which are revolved in opposite directions, the material being fed through a hopper at the top. By this means it is reduced to a fine powder, when it is again bolted in revolving sieves, and is now ready for moulding into shape. This process is performed by men occupying booths or pockets, of which there are twenty-eight arranged on either side of a line of three endless conveyors, seventy feet in length, and each about eighteen inches wide. The middle conveyor travels in an opposite direction from the others, and twice as fast, and in the direction of two hydraulic presses, located at the end of the conveyor. The bin in each moulder's booth is filled at night with a sufficient supply of material to last him for a day. The moulds are of metal, made in two parts, and contain grooves for from twelve to eighteen pencils, depending upon the diameter of each. Each moulder carefully weighs out sufficient material (which is now a fine powder), to fill one of the flasks, which are kept hot by means of natural gas jets that are burning under the grated surface of the table. One half of the flask being filled and smoothed off with a straight edge, the other half, somewhat smaller, is placed on top of the powder, and slightly pressed down by hand. The mould when filled is slid across the first conveyor to the middle one, by which it is carried to the presses, where two attendants move it to the right or left, upon the hydraulic press plungers, which are thirteen inches in diameter, and which are started by a foot lever, and when the pressure as indicated by a gauge comes up to 350 tons, it is automatically cut off and the mould released. The attendant places it on one of the returning conveyers, and one is taken off by each moulder in turn, when they remove the pencils which are held together by a thin web of material. These are then placed in racks and removed to the dressing table, where they are broken apart by a wedge-shaped tool that is hit with a light hammer. This work is performed by boys, who become very expert. The pencils are then fed by hand into a dressing machine, in which they are drawn through between two steel discs about six inches in diameter, set at an angle to each other, and which have sharp cutting edges and are revolved slowly, so that the edges are kept true and perfect. By this process the material that composed the web is shaved off, leaving the pencils smooth and cylindrical. The pencils are then packed in trays and are ready for the baking process. This is done in furnaces, of which there are 21 in the first factory. These each have a capacity of from 60,000 to 100,000 pencils. The walls of the furnace are of fire brick, and are arched over with the same material, made in sections, so that they can be readily moved for filling or cleaning. The pencils are carefully piled in layers to the depth of four feet, there being a thin course of black sand between each layer of carbons. Being filled, the top is replaced and jets of natural gas are turned in at the front. The walls are perforated with flues along the upper edge on each side, so that the flames pass over, down the side, and under the mass, bringing it to a uniform heat. The process of baking including the time for packing and cooling, requires about three weeks. The pencils are then removed and placed on racks, by means of large steel-tined forks, like hay forks used by farmers. They are next taken to the sorting room, and are assorted for the purpose of removing the "crooks" from those that are straight. This is done by allowing them to roll one at a time down an inclined plate, set at such an angle to the eye of the operator that he can detect by looking under any unevenness in the pencil. The crooks are removed and are cut into shorter lengths, making from 7 to 10-inch carbons, while the ordinary lengths are from twelve to fourteen inches. From the sorting room some go directly to the packing department, while those that are to be copper plated are taken to the plating department. In this process the pencils are suspended from copper bars being attached by plating snap. These are then immersed in a solution containing copper plates, about four hundred pencils being placed in each vat. The plating process requires about twenty minutes, the electrolytic action being set up by means of a current from two generators, one having a capacity of eight hundred and the other of five hundred amperes. The pencils are then removed to drying racks, and when thoroughly dry are packed for shipment, from five hundred to one thousand being placed in each box, depending upon the size of the pencil.

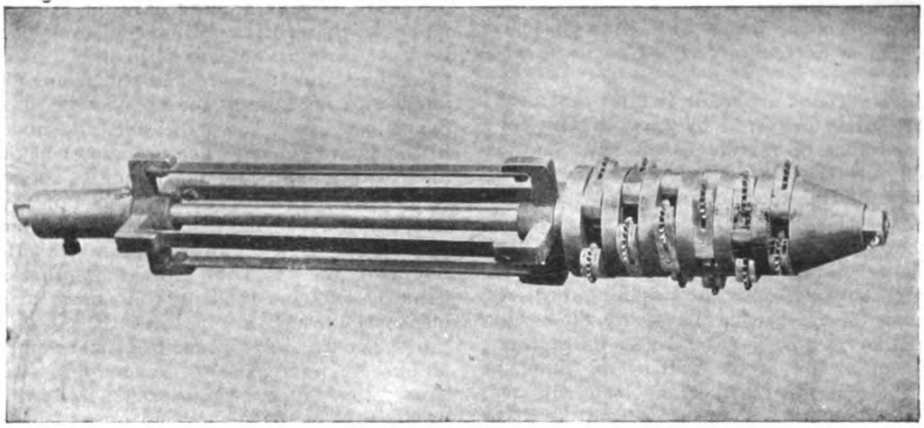
In the second factory, where the pressing process is employed, the material is ground and prepared in about the same manner as described above, when it is pressed by hydraulic power into cylinders 6 by 6 inches. A number of these are then placed within the chamber of one of the large horizontal presses, of which there are four. A brass follower is then inserted, and the plunger of the hydraulic press forces this against the charge with a pressure of 250 tons, forcing the material through a die at the outer end of the cylinder in a continuous rod, and of any size that may be desired, depending upon the die, from one-half inch in diameter up to three inches for cylindrical bars, and four inches square for the larger sizes, and flat bars of all sizes. The bars are then cut up into suitable lengths and are baked in furnaces as before described, when the pencils are pointed on an emery wheel. In these hydraulic machines the cored carbons are also formed.

The power for operating the machinery is derived from two Westinghouse compound engines of 100 horse power and an engine of another type of 50 horse power. The station is equipped with two lighting generators, one for arc, and the other for incandescent light; there is also a machine shop and tool room for making dies and doing general repair work.

The testing department occupies the second floor of the office building, where samples from each of the furnaces are thoroughly tested, both for light and efficiency and for resistance. For testing the length of an arc a small lens is provided, which throws the shadow upon a graduated sheet, and there are several cupboards lined with asbestos with plates of colored glass in the doors for making the various tests in lamps of the durability and character of the ray. Samples of all material when received are carefully subjected to a chemical test and every precaution is used to produce perfect carbons of a high grade for any kind of service.

The Union Boiler Tube Cleaner.

THE users of steam were made glad by the introduction, in 1895, by the Union Boiler Tube Cleaner Company, of a mechanical device that satisfactorily solves the perplexing problem of the removal of scale from the tubes of all boilers of the water tube type. The device illustrated in this connection not only removes the scale, no matter how thick or hard, but in turn so polishes the interior of the tubes by removing even the mill scale, that it makes it impossible for scale to adhere so tenaciously in the future, making subsequent cleaning relatively easy, while it greatly adds to the efficiency of the boilers, by improving the circulation, increasing the radiation, resulting in a saving of fuel. The device, as shown, consists of a conical head, having a taper of about ¾ of an inch, and which is composed of discs, between each pair of which are pivoted three short arms, which carry at their outer end to other wheels or cutters about 1⅛ of an inch in diameter, the arms being set spirally. Back of the tapering head there is a series of guide bars, supported by bearings in which the operating rod revolves. The cone is somewhat smaller than the tube, and being inserted, it is given a rotary motion of about 1,600 revolutions per minute, so that the arms which have a range of from 3-16 to ⅜ of an inch, fly out from centrifugal force, bringing the cutters in contact with the scale on the walls of the tube. The action of the teeth of the cutter wheel is not a scraping or grinding one, but is an impact or vibratory movement, caused by the roughness of the scale, from striking which the arms retreat, after a blow, and immediately return, so that the points of the teeth as they revolve cut into and disintegrate the scale, which is continually flushed out by a stream of water that is fed into the tube by a hose as the process goes on. The scale being removed, the cutter wheels simply revolve on the inner walls of the tube and lose their vibratory motion, so that they have no effect on the tube, except to burnish it, but do not injure or expand thin tubes. The arms, discs and cutters composing the head are made of a high grade of tool steel, and are tempered by a special process, making them very durable. With this machine a man can clean from 20 to 50 tubes a day, depending upon their condition, or whether it is the first or second cleaning.



DEVICE FOR CLEANING WATER TUBES OF BOILERS.

This company manufacture two types of heads, one rigid, the other flexible, the latter designed for boilers having curved tubes, and which is operated by a flexible shaft, the other is straight, and is operated by a rigid shaft. In the process of cleaning a platform about 10 feet long is first erected, the full width of the boiler, and a little below the lower row of tubes. The boiler doors being removed, the tubes are uncapped, both front and back, when to the door hinges brackets are bolted, to which is attached an adjustable cross-bar, which carries the driving head. For cleaning straight tubes, the cleaning head is attached to a straight rod, which is given a rotary motion by means of a driving pulley, through which the rod slides, a sleeve with a key way being provided. By means of a handle on the outer end of the rod the operator can move the head at will back and forth in the tube, without interfering with its rotary motion. The driving pulley is operated by a continuous rope belt, consisting of two or three strands, which is driven from a steam engine, or from an electric or other motor, as the conditions may demand, from 5 to 10 horse power being required. When a rod is fed through the pulley, the handle is removed and a second rod is fastened on with a snap coupling, when the handle is replaced at the end. These rods are made in about 6 feet lengths and may be coupled together sufficient for any length of tube.

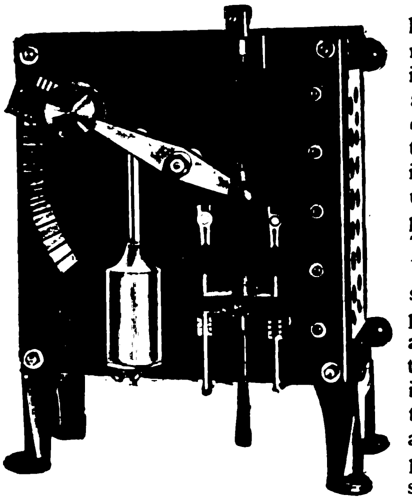
For cleaning curved tubes a flexible head and a flexible shaft are employed. This shaft is composed of solid brass links of peculiar shape; this shaft or chain in turn is enclosed in a closely fitting spirally wound tube, composed of peculiarly shaped wire, flat on the inside, which gives a smooth bore in which the link chain operates. The spirals are also dished on the outside to provide a firm hold for an oil proof rubber tube, by which the shaft is encased, allowing for oil lubrication, but protecting the shaft from the effects of the flushing water, which is led into the tube as described for the straight shaft.

For revolving the shaft, especially the flexible one, the company have recently devised a high-speed, noiseless air motor, which can also be operated by steam. This is a self-contained motor having three trunk pistons, which are attached to the same crank pin, making a very compact machine. Motors of this design of one-half horse power capacity weigh only 26 pounds and contain only 21 parts, and are so designed that when running at a speed of 2,600 revolutions per minute they can be reversed without shutting off the steam. The company contemplate the use of this type of motor, not only for boiler cleaning purposes, but for the propelling of yachts and mechanical vehicles, and for operating small isolated electric light plants, the air to be supplied in seamless tubes under high pressure, the tubes to be refilled and returned when exhausted.

It is the practice of the company to either sell their tube-cleaning device outright, or rent them to steam users by the year, or contract to clean boilers for so much per horse power. In all cases where a sale or lease is effected, an expert is sent to install the device and give instructions as to how it should be used, without charge.

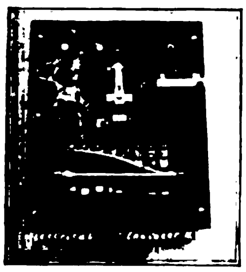
The shops for the manufacture of tube cleaners and motors occupy the fifth floor of the Imperial Power Building, 251 Pennsylvania avenue, Pittsburg, equipped with a complete assortment of metal-working tools. The company's office adjoins the shop.

Gravity Motor Controller of the Electrical Appliance Co., N. Y.



The device represented herewith possesses many meritorious features. It is very simple in design, and durable. Few parts enter into its construction. Particular attention is called by the manufacturers, the Electrical Applance Company, 27 Thames street, New York City, to the absence of numerous complicated operating parts; also to the contacts and the use of a non-conducting device for securing tension, of such design as to take up all the wear possible. Realizing the severity of the service required, they have made adequate provision for it. The controller can be readily attached to belted elevators by making rod connections direct from the belt shifting wheel, or the wheel operated therefrom. This controller can be used for starting an elevator and motor simultaneously and for starting the motor in advance of the elevator, but still retaining the automatic cut-off feature. That is, when the elevator car stops, the motor does also. It can also be arranged for starting and stopping the motor independent of the elevator or other apparatus. These controllers are made in sizes varying from 3 to 50 h. p., and are designed for the control of elevators, motors, pumps, presses, cranes, etc.

Ohio Electric Specialty Mfg. Co.



The Ohio Electric Specialty Manufacturing Company, of Troy, O., manfacturers of "Perfection" all-copper woven wire bronze gauze, and leaf copper brushes, the Rogers commutator lubricant, "Imperial" rheostats, speed regulators and motor starters, have lately received numerous orders for this latter device, which is illustrated herewith. The motor starter, with over-load device, has all the advantages of the company's regular automatic motor starter, besides protecting the motor from overload, short circuit or other causes of damages. The overload device acts in conjunction with the automatic release plate by protecting the armature and commutator against the sudden rush of current due to a short circuit or other cause. It is a complete protection to the motor, and is made for any size, voltage, resistance of field and make of motor. The company are prepared to send on trial any of their goods, which, if not satisfactory, can be returned at their expense. A catalogue illustrating the company's numerous specialties will be sent to anyone upon application.

A Big Walker Generator for Boston.

The Boston Elevated Railway Company has placed an order with the Walker Company, of this city, for the construction of a direct current generator which will be the largest ever built. This monster generator will have a capacity of 4,000 h. p. and will be capable of delivering over 5,000 h. p. for a few hours at a time. The machine will weigh 300,000 pounds, the armature alone weighing over 100,000 pounds. To drive this great machine will require an engine of nearly 5,000 h. p., and the generator armature will be placed directly upon the shaft of the engine.

INVENTORS will discover from Edward P. Thompson's recent circular that his power to maintain the single specialty of soliciting patents for fifteen years is due largely to his being an electrical expert as well as versed and experienced in the law relating to patents.

Locke Victor Insulators.

Mr. Fred M. Locke, of Victor, N. Y., forwards us a copy of his patent, No. 605,109, of June 7, 1898, covering his latest forms of triple petticoat high tension insulator, with a long, central petticoat glazed inwardly, the insulator being of three shells of vitrified china, and then all fused together with the glaze into one homogeneous insulator. Mr. Locke warns that he will protect his rights and that he proposes to collect royalties.

Westinghouse Induction Motors in South Carolina.

The Westinghouse induction motor, known as the type "C" machine, has recently extended its usefulness to a unique field in North Carolina, namely, the operation of fertilizing machinery. The Westinghouse Company has recently supplied the Fries Mfg. Co., of Salem, N. C., with six of these motors, and a number of lightning arresters, high tension transformers, etc., which are to be used for the above purpose, and also for driving a city pumping station, planing mill, machine shop, iron foundry, etc. The choice of Westinghouse motors was made largely on account of their extreme simplicity. They will be operated by workmen entirely unfamiliar with electrical machinery. This is one of the first installations of the character in North Carolina, and is being watched with great interest throughout the State.

C & C Electric Co.

We understand that the C & C Electric Company, of New York, are still getting their usual large number of orders, in spite of the war, and are not complaining at all. Their factory continues to run day and night with a large force of men, as it has done for nearly a year. They are receiving their usual large number of orders for their bipolar dynamos and motors, while their orders for slow speed multipolar generators and motors are still most gratifyingly large. During the last month they have taken some excellent orders for electric lighting and power installations, including not only the machines, but the complete plant. Among these might be mentioned two secured from the American Fisheries Company for complete installations at their establishments at Promised Land, L. I., and Lewes, Del., each of the plants including a 30 k. w. generator, the one at Lewes being a belted machine, and tnat at Promised Land being an engine type, direct connected to an Alfree engine, which the C & C Company is also to furnish. In addition to these, the company took the contract for the wiring, lamps, etc. They are also installing a 100 k. w. direct connected generator and a 175 h. p. Buckeye engine, together with switchboard, etc., in the large establishment of the H. B. Claflin Company, New York. Their Louisville representative, Mr. J. H. Cochran, has taken orders from the Tobacco Warehousing and Trading Company, of Louisville, Ky., and Danville, Va., for complete lighting and power plants for their two establishments located at these places. In each case the installation will consist of two 20 k. w. engine type generators direct connected to Watertown vertical engines, which the company is also furnishing, together with two special slow speed blower combinations, each blower being fitted with a variable speed eight pole 10 h. p. motor with double commutator; also two 24-inch exhaust combinations. The plants will be exact duplicates. The company has also recently received numerous orders for its closed type ironclad motors of various sizes, besides a number of marine generating sets, in which Case engines direct connected to closed type ironclad dynamos will be used. There is still a very active demand for their back-geared ironclad motors and electric hoists, which have met with universal favor.

NEWTOWN, Pa. The Standard Telephone Co. has contracted with A. M. Worstall, of the Witherspoon Building, Philadelphia, for the installation of its system, the apparatus being built by the Pennsylvania Electric Company, of Marietta, Pa. The switchboard capacity is 50 drops, and the rates are $12 for residences and $18 for business offices. The toll line rate is 10 cents for eight miles. Toll lines have been put in to Bristol, Doylestown, Quakerstown and Lansdale. The capital stock is $10,000. Mr. H. C. Worstall, is president, W. P. Church, secretary, and E. P. Hicks, treasurer.

CATALOGUES.

The Hoppes Mfg Co.

The Hoppes Mfg. Co., of Springfield, Ohio, have just issued a very elaborate descriptive catalogue and price list of their well known live steam feed water purifiers and exhaust steam feed water heaters, and of the Hoppes steam separator, which they have recently brought out. The Hoppes specialties and their admirable features are so well known to boiler users and engineers that they need no further comment here, except, perhaps, that the demand recently for the purifiers and heaters has been on such a large scale as to surprise even this enterprising company itself. The catalogue, which contains 56 pages, is well illustrated and neatly arranged, and will be sent to anyone upon application.

Chicago Belting Co.

A very attractive and interesting as well as instructive catalogue has just been issued by the Chicago Belting Co., of Chicago, Ill., makers of leather belting and dealers in mill supplies. The catalogue contains price lists and modes of manufacture of pure oak-tanned leather belting, and a special chapter on the production of dynamo belting. These latter belts are always made endless at the factory, where the company have special machinery. They also manufacture straps, round leather belting, lace leather, and deal in such supplies as belt cement, glue heaters, belt studs and tools, as well as cotton belting. Nearly one-half of this interesting book is devoted to practical information on belting, which chapters are amply illustrated and highly instructive. The cover has embossed on it a pulley over which a wide belt is running, on which appears the well known trademark of the company, the word "Reliance," so characteristic of the company's products.

Johnson & Morton.

Johnson & Morton, 26-28 Catherine street, Utica, N. Y., are distributing an interesting leaflet illustrating their new style of slate-lined fireproof junction boxes and tablet boards. The particular circuit box illustrated contains a main switch and six flush branch switches, and is very attractive in appearance. The leaflet will be sent to anyone upon application.

Bristol Company.

What appears to us to be a most complete list of recording instruments for pressure, temperature and electricity has just been issued and called a "partial list" by the Bristol Co., of Waterbury, Conn. It includes not less than 117 different varieties and ranges, and the company are continually making additions to meet any special requirements. So universally known and used are these standard instruments that an illustration of each type of instrument and their prices was all that was considered necessary to include in the pamphlet, which will be mailed to anyone upon application.

Chas. E. Billin & Co.

A publication entitled "Machinery and Supplies," published by Charles E. Billin & Co., engineers, 1533 Marquette Building, Chicago, Ill., has just made its second appearance and might be called a combination catalogue and text-book. It is published monthly by this well known firm, who carry on business as engineers and forwarding agents. The book contains catalogues and price lists of a number of manufacturers of machinery and supplies whose space varies from one to ten pages, the descriptions, cuts, and prices being furnished by each firm. Among the items in this number are descriptions of several stamp-mill equipments, articles on insulated and copper wire, power-hammer installations, wood-split pulleys, tables and other interesting information.

WAR TELEGRAPHS. The estimates of General Ludlow, recently submitted to Congress by Secretary of War Alger, provide for $195,000 for special electrical communication for the army in Cuba, Porto Rico and the Philippines.

Whitney Pocket Voltmeters.

Electric Appliance Company are calling attention in our advertising columns to the new Whitney pocket voltmeter, which is bound to find a large field of usefulness, particularly among telephone companies where an accurate voltmeter of low range

is desired. This instrument is about the size of an ordinary watch and can be very easily carried in the pocket. It has every advantage of a regular battery gauge with the additional advantage of being an exact and accurate scale.

WESTERN NOTES

CLOOS ELECTRICAL ENGINEERING COMPANY has been formed in Milwaukee, with headquarters in the Cawker building. The officers are: President, H. W. Falk; vice-president, electrical engineer, etc., Jacob Cloos; secretary, E. A. Wuerster; assistant secretary, C. H. Falk; treasurer, H. R. King. The concern will do a regular engineering business.

DAYTON FAN AND MOTOR COMPANY, Dayton, O., state that they have not shut down their factory for one hour during the past three months, but have had to run day and night shifts. Mr. E. O. Waymire says their trade has grown to such proportions as to necessitate the renting of larger quarters in the near future to keep up with their fan motor business. The company employs at present 100 hands steadily.

CRAIGHEAD ENGINEERING COMPANY, of Cincinnati, O., are furnishing their Craighead flexible brackets to the Grand River Electric Railroad, running from Detroit to Pontiac, Mich. The road will probably be 35 miles in length when completed and is likely to require 1,600 of these brackets for the complete equipment.

KEMPSTER B. MILLER, who for some time past has been superintendent and electrician for the Western Telephone Construction Company, of Chicago, will leave that concern on July 1, to take charge of the telephony instruction in the International Correspondence Schools, at Scranton, Pa., and also take up some personal lines of work which he has long desired to follow out but which time has not heretofore permitted him to develop. Mr. Miller, although a young man, has recently risen to be considered one of the leading authorities in the independent telephone field.

AMERICAN CARBON WORKS, Noblesville, Ind., notwithstanding the great increase in the machinery put into their factory, report that they are extremely busy and are working to the fullest capacity. The outlook for trade is excellent.

MASON ELECTRIC EQUIPMENT COMPANY, Chicago, requests that as its Mr. E. R. Mason has been called into active service as a member of the Naval Militia of Illinois, all orders be sent to its St. Louis office, 314 Security building.

THE CENTRAL ELECTRIC COMPANY report a number of new specialties in their house goods department, prominent being a new device for electrically lighting the incandescent gas or Welsbach burner. It is a marvelously simple device and will doubtless be appreciated by the trade, which has been asking for a device of this character.

WESTERN ELECTRIC COMPANY wishes to quote prices to central stations on Lakon transformers and transformer cut-outs.

MR. R. H. BOUSLOG, the general manager of the Peru (Ind.) Electric Manufacturing Company, writes us: "The business of this concern is in a very prosperous condition. The new line of goods, especially the new plug and plug cut-out, is popular and inquiries and orders are coming in from all directions. We have twice the number of hands employed that we had a year ago, and certainly see no reason for complaint."

CRESTLINE TELEPHONE COMPANY has been formed lately with a capital of $10,000 by W. S. Johnson, secretary and treasurer, and E. R. Law, manager, the former at Van Wert and the latter at Crestline. There is a switchboard capacity of 100 drops, and 100 subscribers at rates from $18 to $30. The local circuits are five miles in length, and toll lines are being run in different directions.

CANADIAN PACIFIC TELEPHONE COMPANY has met the cut in rates of the Western Union Telegraph Company on the Pacific coast, the cut to some points amounting to a reduction of nearly 80 per cent.

NEW YORK NOTES.

WARREN-MEDBERY COMPANY, of Sandy Hill, N. Y., are now manufacturing a full line of Medbery switches and switchboards in all their various styles. They will shortly be able to supply the market with all styles of their celebrated Medbery insulation for electric railways. It is already in great demand, and its popularity will grow.

BUFFALO, N. Y. J. L. Alberger & Son have furnished the National Electrotype Company with one 40 h. p. Crocker-Wheeler motor to drive refrigerating machinery with current from Niagara Falls. The same firm are supplying other Crocker-Wheeler motors to run on Niagara power, including the five-story candy factory of Sibley & Holmwood, for which Mr. H. A. Foster was consulting engineer.

NEW YORK EDISON COMPANY shows a gross for the five months of 1898 of $1,326,567, a gain of $270,661 over 1897 in gross and a gain of $97,263 in net. The net gain in May was $24,094.

CROWN INCANDESCENT LIGHT COMPANY, of Camden, N. J., has been formed with a capital stock of $100,000 by J. Pechin, R. Barr, J. Green, of Camden, and L. A. Repetto, of Atlantic City, N. J.

ERICSSON TELEPHONE COMPANY, of Utica, N. Y., has been formed under the laws of West Virginia with a capital stock of $100,000, the shareholders being L. P. Smith, J. F. Hemenway, A. M. Hemenway, W. C. Wilson and H. E. Higgins. The headquarters are located at Utica.

THERMO-ELECTRIC COMPANY, of New York City, has been formed by A. H. Woodbridge, Lyons Farms, N. J.; M. M. Armstrong, Philadelphia; L. S. Langville, Oscar Taussig, A. Rindskopf, H. L. Dyer and Merle J. Wightman, of New York City.

RED BANK, N. J. A. C. Greenberg has allowed judgment to be taken against him for $30,686 in favor of A. B. Fletcher on a claim as endorser on eleven notes of the Atlantic Highlands, Red Bank & Long Branch Railroad Company, of which he was president, and which is now in a receiver's hands.

THE GOUBERT MANUFACTURING COMPANY, 14 and 16 Church street, New York, has secured from the Metropolitan Street Railway Company, of this city, the contract for feed water heaters for the mammoth power station being erected at Ninety-sixth street and East River. The first installment consists of 30,000 h. p. in six heaters, horizontal type, and rated at 5,000 h. p. each. They are to be placed between the low pressure cylinders and the condensers. It is said to be the largest single order for feed water heaters ever placed in this or any other country.

BROOKLYN TROLLEY CARS on Decoration Sunday carried over 1,000,000 passengers and could have handled more had there been cars enough and power enough to drive them. The traffic was admirably taken care of.

NEW ENGLAND NOTES

AMERICAN ELECTRICAL WORKS, of Providence, by way of a souvenir for Decoration Day, issued a steel portrait of Abraham Lincoln, accompanied by a quotation from his Gettysburg address, at the dedication of the National Cemetery there.

WILMOT & HOBBS MANUFACTURING COMPANY, of Bridgeport, Conn., are making extensive additions to their manufacturing plant, which consists of two large buildings. These buildings are to be used as an engine and plating room and a machine or manufacturing building. The engine and plating building is about 60 feet wide and 100 feet long, two stories high, steel frame construction, with brick side walls and concrete floors. The machine building is about 80 feet long and 135 feet wide, and three stories high. This building is of steel skeleton construction throughout. The floors are designed for heavy loads and are carried on corrugated iron arches supporting concrete filling. The aim in the designing of these buildings has been to get the most convenient structures possible and the maximum amount of light consistent with stability of structure and with economic construction. The designs of the buildings were made by the Berlin Iron Bridge Company, of East Berlin, Conn., who furnish and erect the structural steel work.

HOLYOKE, MASS. The Lyman Mills, which is the largest mill corporation of Holyoke, Mass., employing about 1,500 hands, are a progressive concern, and their recent adoption of electric power for the operation of their machinery will undoubtedly have a marked influence upon many other firms in the vicinity. The Westinghouse Electric and Manufacturing Company has installed for the mills a 250 kilowatt, 440 volt, two-phase, 3,600 alternation generator, direct connected to an Allis-Corliss engine running at 120 r. p. m. Six Westinghouse type "C" motors, varying in size from 30 to 75 horse power, are used for the operation of spinning frames, looms, the machine shops, etc.

WATERVILLE, CONN. The new building which the Waterville Cutlery Company are erecting will have a steel roof which is being erected by the Berlin Iron Bridge Company. The trusses are steel, and the covering is corrugated iron lined with the Berlin Company's patent anti-condensation fireproof lining. The building is 21 feet wide and about 100 feet long, and is to be used as a forge shop in one end, and in the other will be located the boilers and engines.

FOREIGN OPINION.—The long-established weekly eclectic magazine, The Living Age, never deserved its title better than now; for its presentation of English and Continental opinion on the various aspects of the war between the United States and Spain is fresh, full and widely representative; yet it does not trench at all on the other admirable features of the magazine.

BRIDGEPORT, CONN. The Canadian Bryant Electric Company has been organized at Bridgeport with a capital of $5,000, in 200 shares of $25 each, $2,500 paid in. The subscribers are: W. C. Bryant, 72 shares; L. W. Eaton, 34; J. B. Hubbell, 30; E. W. Marsh, 30; H. A. Hubbell, 24; E. M. Scribner, 10. The company has a factory at Montreal.

PORT CHESTER, N. Y. The new power house now being erected by the Port Chester Street Railway Company is a building 45x84 feet, and consists of a boiler room, engine and dynamo room. The building has brick side walls, in which are built steel columns, supporting steel truss roof. In the engine room is a traveling crane arranged so that any part of the engines or dynamos on the floor below can be readily lifted and moved from one place to another. The power house is built in a substantial manner, and is a well-designed modern station in every respect. The steel work for this building was designed and is being erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

American Electric Vehicle Co.

C. F. Smith, president of the Indiana Bicycle Company, has returned from Chicago, where he went to complete the deal for the controlling interest in the American Electric Vehicle Company. The arrangements for the purchase were satisfactory and Mr. Smith and his financial associates secured the stock. The company was immediately reorganized, with C. F. Smith, president and general manager; Philip Goetz, vice-president, and L. S. Dow, secretary. The entire business of the carriage company will be removed to Indianapolis, and the manufacture of electric carriages will be begun. The new industry will give employment to from 1,000 to 1,200 men.

General Electric Automobile Co.

The General Electric Automobile Company has been organized under the laws of West Virginia, with an authorized capitalization of $2,500,000, divided into 50,000 full-paid, non-assessable common shares of the par value of $50 each. There is no preferred stock nor any bonds. Of the total common stock authorized there have been issued 35,000 shares, 20,000 of which are held intact by the controlling interests, leaving 15,000 shares taken over by a syndicate. As an asset for future use there remain in the treasury 15,000 shares. It is also understood that the treasury will have at the beginning of business a large cash balance. The head offices of the company are in Philadelphia. The Board of Directors includes J. A. Brill, Prof. W. D. Marks, Rudolph M. Hunter and John H. Noblit.

ADVERTISERS' HINTS

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., advertise Whitney pocket voltmeters reading to five volts. These little instruments are about the size of an ordinary watch and are easily carried in the vest pocket.

C & C ELECTRIC CO., 143 Liberty street, New York, call attention to their marine type generating sets in sizes from 2½ to 15 k. w. In these combinations their well known closed type of ironclad dynamo is used, making practically a waterproof outfit.

THE WAGNER ELEC. MFG. CO., St. Louis, Mo., advertise alternating current ceiling fan motors for 7,200 alternations, at prices that must prove interesting.

D. A. HEUBSCH & CO., New York, get out a year book which proves an excellent souvenir for presentation to customers.

HENRY R. WORTHINGTON, New York, about a year ago, began fitting all Worthington pumps with forged steel valve motions and links. Although costing more, they say the difference is worth the expense.

THE UNION STORAGE BATTERY CO., 1063 Hamilton street, Cleveland, Ohio, claim their battery cannot be excelled as accumulators, regulators, boosters, equalizers, etc. It was described in detail in our last issue.

THE WARREN-MEDBERY CO., Sandy Hill, N. Y., the manufacturers of the new Warren inductor alternator, publish a full list of their sales' offices.

THE HOLTZER-CABOT ELEC. CO., Boston, Mass., call attention to the improved Holtzer automatic gas burner.

Quiet and Strong Conditions.

The following quotation from Bradstreet's sums up the situation neatly: "Unprecedented foreign trade totals, involving heavily increased shipments of breadstuffs, provisions, raw cotton and manufactured products; flattering crop prospects, pointing to very large yields of wheat and most other cereals, as well as cotton; profitable railway operations, as reflected in relatively heavier gains in net than in gross receipts; activity in nearly all lines of manufacturing except some textile branches; prices for most staples showing heavy advances over the preceding year; bank clearings, exceeding all previous records at this date; a volume of new demand limited in the East and South to midsummer dullness, but in the West and Northwest comparing favorably with records of previous years, and a low rate of business mortality, are all features of the general business situation at the present time."

During the week 8,292 shares of Western Union were sold, closing at 91¾. Of General Electric, 8,518 shares were sold, easing off from 39 to 37¾. In Boston, American Bell Telephone went down from 275 to 271 on sales of 583 shares.

Copper in New York last week was 11.87½. Heavy steel rail, Eastern mill, $17.50. Lead, New York, was 3.87½.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXV. JUNE 30, 1898. No. 530.

ELECTRIC LIGHTING

The Proper Illumination of City Streets.

BY HENRY HOPKINS,

Superintendent Street Lighting, New Haven, Conn.

THERE probably has been no subject connected with modern municipalities that has come to the front more in recent days than the question of efficient street lighting. And the field is one that a great deal of thought and study can be expended on with profit by those connected with city affairs. Well lighted streets make it safe for us all to travel about after nightfall, and also show a prosperous and wide-awake community.

The word "proper" as used in connection with the subject must be used as directly referring to the particular era or age in which the comparison is made. Thus the city of New York when it passed an ordinance in 1697 required that the residents of every seventh house should place a candle burning lantern out of the second story window suspended on a pole, followed by Boston in 1774 with oil burning lanterns. The people of that age called it proper street illumination, because it was the best obtainable at that time. We recall their existence as "has beens." The following homely poem will convey the idea:

> In olden times along the street
> A glaring lantern led the feet
> When on a midnight stroll,
> But now when night is nigh
> We catch a piece of lightning from the sky
> And stick it on a pole.

The problems that we have to overcome are dark pavements, angular streets and the foliage on the trees. I believe the time will come when light colored pavements will be considered in connection with street lighting; angular streets may be overcome to a certain extent, but the foliage on the trees is like the candidates for our places, always haunting us. Judicious trimming will greatly assist in good street lighting; the lamps are not to blame and the trees certainly are not, for they were there first.

What are the requirements for satisfactory street lighting? We can find many, but the four that present themselves to me are:

First. The most modern system. It should be borne in mind that prospective residents and manufacturers consider this point.

Second. The most reliable system at all times under adverse circumstances, such as high winds and severe storms.

Third. That system in which it is nearly impossible for evil disposed persons to interrupt the service.

Fourth. And an all important factor—the system giving under all circumstances the most illumination blended with the fulfillment of the three preceding requirements. Leave one of them out and the general result desired is lost. The first one can be easily answered, as its birth is of recent date. For the consideration of the second requirement study the above table.

FIG. 2.

EFFECT OF HIGH WIND ON LIGHTING SERVICE.

RECORD FOR NIGHT OF NOV. 9, AND MORNING OF NOV. 10, 1897.

Lighted, 4.30 to 5.30 P. M. Extinguished, 5.45 A.M.

Velocity of Wind per Hour.	Electric		Welsbach.		Plain Gas		Naphtha.	
	Out.	Broken.	Out.	Broken.	Out.	Broken.	Out.	Broken.
18 miles, 5 P. M., 9th	..	..	1	..	3	1	29	..
18 " 6 P. M., "	..	..	1	..	3	1	29	..
38 " 7 P. M., "	..	..	1	..	3	1	30	..
32 " 8 P. M., "	..	..	1	..	3	1	33	..
40 " 9 P. M., "	..	..	1	..	5	1	54	..
30 " 10 P. M., "	..	..	1	..	5	1	62	..
30 " 11 P. M., "	..	..	1	..	6	1	62	..
28 " 12 P. M., "	..	..	1	..	7	1	70	..
21 " 1 A. M., "	..	..	1	..	8	1	74	..
18 " 2 A. M., "	..	..	1	..	8	1	77	..
20 " 3 A. M., "	..	..	1	..	8	1	77	..
11 " 4 A. M., "	..	..	1	..	8	1	77	..
12 " 5 A. M., "	..	..	1	..	8	1	77	..
Totals	..	..	1	..	8	1	77	..

Shortly before 8 p. m. there was a gust of wind that registered 60 miles.

Number of electric lamps	442
" of Welsbach lamps, gas	105
" of plain lamps	633
" of naphtha lamps	512
Total	1,692

The third requirement can be answered by any school boy of the present day.

For the fourth consider Fig. 1.

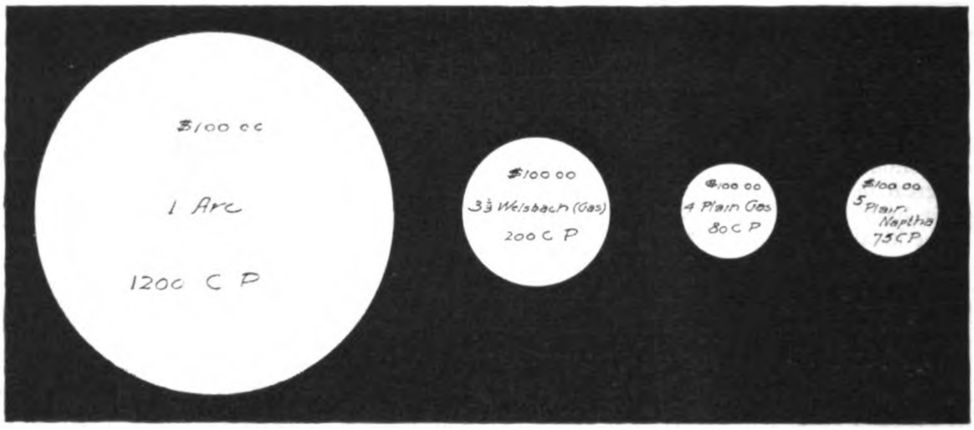


FIG. 1.

This cut shows the light producing power obtained for $100 on the following basis:

One 1,200 candle power arc costing $100.

Three and one-third 60 candle power Welsbach gas lamps at $30 each, 200 candle power for $100.

Four 20 candle power plain gas lamps at $25 each, 80 candle power for $100.

Five 15 candle power plain naphtha lamps at $20 each, 75 candle power for $100.

That the electric arc light is not liable to be superseded at present is shown by the fact that in our city it was introduced in 1884, and since that time under nineteen committees and four superintendents not an arc light has been discontinued, while 1,081 gas and naphtha lamps have succumbed to progress. Yet at this time I desire to put myself on record as admitting that for certain places and under certain circumstances arc lights are out of place.

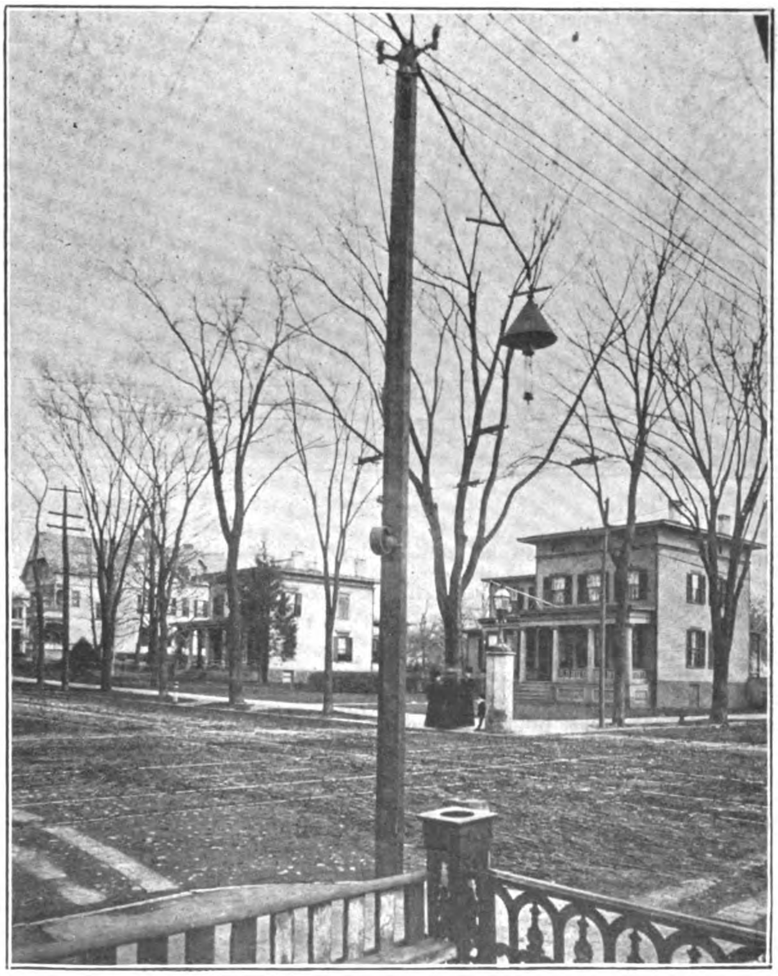


FIG. 3.

The locality should govern the system and it should be practical lighting, not political lighting, and thus an efficient service will be built up. On account of the high candle power of the electric light it is especially adapted for parks, bridges, railroad crossings, in front of public buildings and for the business sections and on corners. While as an auxiliary to the above, Welsbach gas lamps can be used between the blocks and on residential streets where they are angular and the trees are dense. In outlying districts, where there are no gas mains, naphtha lamps can be used to advantage. Locating of lamps can be done more advantageously after dark. A few illustrations are here presented.

Fig. 2 shows a junction of three streets, a trolley track and a watering trough. The light is placed on a pole, a light on arm extension would not distribute the light evenly.

Fig. 3 shows an avenue and cross street with double trolley tracks on both streets. An arm is here used to convey the light bearer as near the center of the most dangerous part of the roadway as possible, yet the cross walks receive their share.

Fig. 4 shows an elbow made by three streets joining: notice how nicely the lamp is poised so that all points receive an equal amount of light.

Fig. 5 shows a lamp placed on a pole, now changed to arm extension; the cross street opposite is now benefited instead of the building. We should light the streets instead of the sides of buildings.

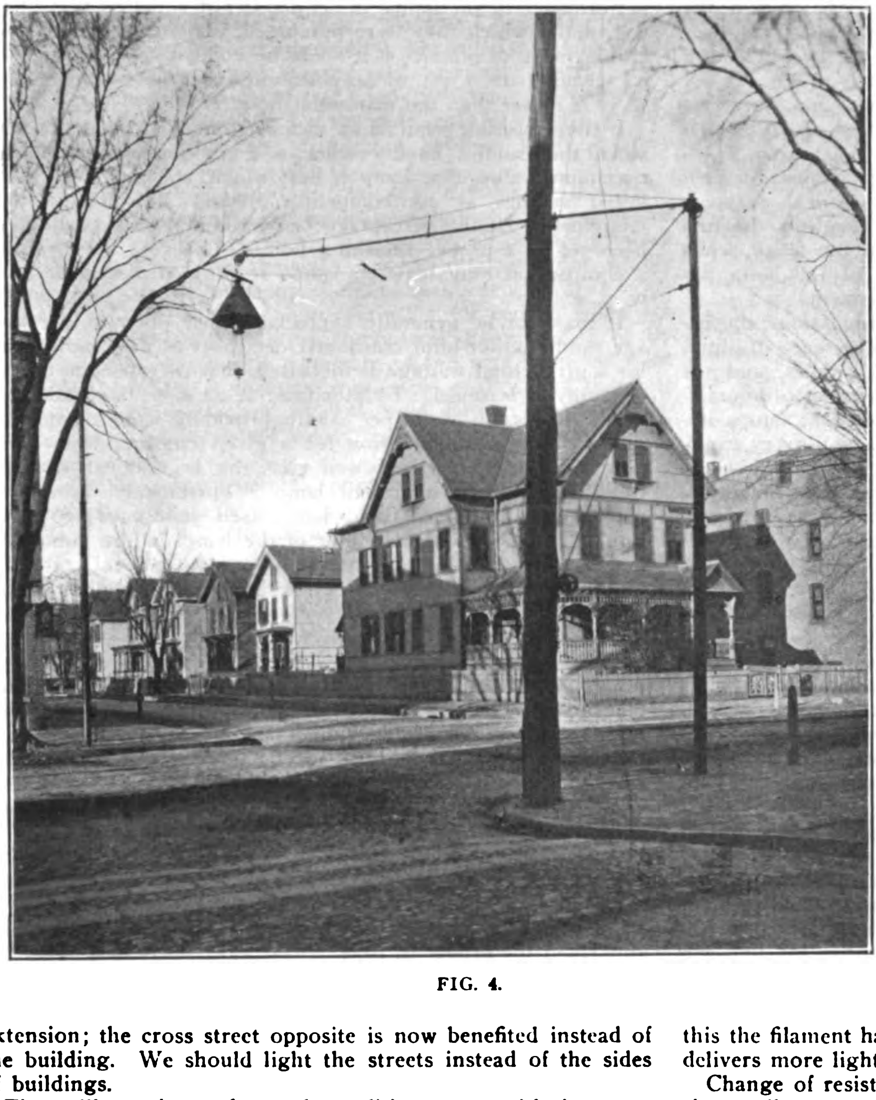


FIG. 4.

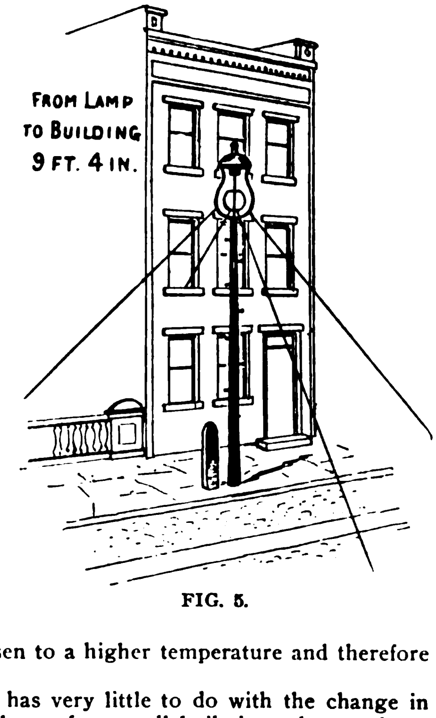


FIG. 5.

These illustrations of actual conditions met with in street illumination in our city indicate most clearly which system all points considered is most valuable. The preceding tables showing the relative candle power of the various systems and particularly treating on the reliability under adverse circumstances as considered in regard to outages must form a conclusive argument. While Welsbach lamps give a fair amount of light, yet the liability of the mantles to crumble after being lighted an i at a time when it is impossible to renew them owing to non-patrol of the lights creates a certain amount of prejudice, which at the present time has not been overcome.

I believe the time will come when the arc light of great candle power will be subdivided into three or four parts and so scattered in locating, and that in the case of illuminated arches between the blocks as used in some cities as an adjunct to arc lamps, the semi-circle will be inverted so as to throw the rays of light down rather than up. And I also predict that the tower system will soon go out of use.

Important Considerations in Lamp Tests When Determining the Best Available Lamp for Central Station Use.[1]

BY S. EVERETT DOANE.

I WANT to begin by saying that an incandescent lamp is of no particular candle power. It is given a rating, but such rating is only partially descriptive.

It is capable of delivering many different candle powers, at as many different voltages. It can, however, deliver only one candle power a tone wattage. It is obvious, then, that, irrespective of resistance, if the surface of the fiilament does not change, the candle power of the lamp will remain the same, providing the wattage delivered to it is constant.

Neglecting for the moment all the exceptions having to do with the color of filament surface, the character of same, and considering for the time being all filament surfaces as alike, the area of the surface has all to do with the candles and w. p. c. at varying voltages. This being the case, it is, of course, clear that a lamp giving certain candle power at 100 volts, will deliver candles if operated at 104 volts, due simply to the fact that more energy is put into the filament, and in radiating this the filament has risen to a higher temperature and therefore delivers more light.

Change of resistance has very little to do with the change in the candle power of a lamp, for a well built incandescent lamp does not change its resistance materially throughout its effective life, although its candle power changes considerably. This being the case, it is obvious that any change in candles without a change in watt consumption must be due to change in the surface of the filament.

How should incandescent lamps be rated? This is not an

[1]Abstract of a paper read before the N. W. Elec. Assoc., June 11, 1898.

idle question. It has been the misfortune of some lamp manufacturers to lose competitive tests, when really they have won, because of an improper analysis of the results by the purchaser, though the purchaser has acted in perfect faith, honesty and to the best of his judgment.

It very frequently happens that the maximum candles are reached, as it may have here, in less than five hours. Observation should always be taken early enough, so that at least two readings, if the lamp rises much in candles, come on the upward portion of the curve. The importance of the statement will be apparent when you note that in this case, if we assume that the readings were not taken until 100 hours, the lamp would have been shown to have risen only 5 per cent., about .8 of a candle. If the readings had been taken at the end of about 170 hours, it could have been assumed that the candle power had not changed from the beginning, and the fact that, having been a rocket, it is now a stick, would be lost sight of.

It is not unusual to see the reports of lamp tests in which the candle power of the lamp is said to have "remained unchanged for many hours." There is a very small chance that this is true of any lamp test. An inspection of the curve for the remainder of the life of the lamp usually shows that the lamp had probably risen very high in candles, and that the first reading after the initial had been taken at the time when the decreasing candles were the same as they were initially, having in the meantime been much greater.

I believe there is no ground for debate on the two following statements:

First—The candle power of an incandescent lamp never remains absolutely constant, and, barring the first sharp rise, it constantly falls.

Second—The curve of change in candles in an incandescent lamp is nearly a straight line, and for all practical purposes can be considered as such. This, of course, neglects the first rapid rise in candles and the sudden slump at the finish, when the defect, which finally causes the failure of the lamp has reached the acceleration period of its development.

In spite of curves, figures, statements and discussions, the belief is still general that the sole gauge of the difference of illuminosity is the difference between the initial candles, and the candle power at the end of a pre-determined number of hours.

This is rarely the case. Almost all incandescent lamps immediately rise in candles. This preliminary rise is very rapid. The maximum candles are frequently reached after the first one or two hours. Such being the case, what is the true initial candle power of a lamp under test, and how much has the candle power rating to do with the ultimate decision of the would-be purchaser?

Why should a lamp be bought and termed "16 c. p." when within an exceedingly short space of time, it gives 18 or 19 c. p.?

Should a purchaser of a three watt lamp be pleased if by its rise in candle power it produces light at the rate of 2½ watts per candle, but subsequently suffers a rapid decrease in brilliancy, because of this high filament temperature? Would it not have been better if illumination at the brilliancy produced by filaments at a 2½ watt temperature was desired, to have consulted some lamp engineer, with a view of producing this extraordinary condition in the best engineering manner? Would any of you dream of over-loading your generators, deliberately closing your eyes to their obvious over-heated condition, and invite final disaster, because your generators were rated to operate at a given number of amperes, and your ammeters lied?

Is it wise to buy lamps labeled 16 c. p. if after the first five hours they rise to 18, and subsequently fall to 14 c. p. or less, giving you very bright and comparatively very dim lamps on your circuit side by side? But such lamps have caused lamps really well made to be considered inferior because the area of candle power of the latter was less, although the real maintenance of candle power was superior.

Why should a manager desire a lamp which rises in candles? If he buys a 16 c. p. lamp, is he purchasing a lamp which he wishes to deliver 18 or 20 candles or more after a few hours? Is he not deceiving himself? Would it not be better for him to understand that he is purchasing an 18 c. p. lamp? Would it not be better for him to buy one actually 18 or 20 c. p., which would not rise in candles? He could thus secure the benefit of the difference between 16 and 20, when the poor lamp was rising, and before it reached the peak of its curve, and at the same time view the conditions of illumination with his eyes wide open.

Fortunately, it is not essential, in discussing a lamp test, to find just the height to which a lamp rises, as the most satisfactory lamps do not rise in candles, or at least rise very little, and readings on these lamps will show that the candle power curve almost from the beginning is very close to a straight line.

To refer back to the original question, what is the proper rating? Should not the definition of initial candle power be the maximum candles during any part of the life? Should not the difference between the maximum and minimum candles be the gauge of the lamp's performance? It would seem to me that by far the best rough method of analyzing a lamp test is to add the per cent. increase to the per cent. decrease in candles, and call it all decrease. A few of us are guarding against this rise in candle power and trying as hard to overcome it, as we are the fall.

Watts per candle rating: After the test it is not unusual for the purchaser to demand that lamps delivered shall not exceed the w. p. c. of the lamps under test, so that the lamp manufacturer is immediately obliged to build lamps which shall average less watts per candle than the lamps under test, with a resulting disappointment to the station manager, because the performance of the lamps in service is not equal to that of the test, under which they were purchased. It would point toward a uniformity of practice if it could be understood that the w. p. c. specified on a set of specifications are the average initial w. p. c. rather than the maximum limit.

If the smashing point of an incandescent lamp is at that time when the candles have reached a given percentage of their maximum value, that lamp is best which, starting at the same initial candles as its competitor, makes the nearest to a straight line to the percentage of maximum candles which has been set as a proper smashing point. This, of course, affords a comparison only between lamps starting at the same initial w. p. c.

It may not be generally appreciated that the cost per average candle power-hour constantly decreases as the candle power for a given total wattage is increased, that is, when the average economy is lessened. To illustrate: A 24 c. p. lamp taking 60 watts, that is, 2½ watts per candle, providing it does not break, gives a greater illumination for a given consumption of watt hours, through a period well past the economical smashing time, than a 20 c. p. 3 watt lamp. Fortunately, or unfortunately, an incandescent lamp lends itself quite easily to deception. A little rough handling of the lamp on the pumps will blacken the filament and reduce its candle power. But this blackening is radiated after a few hours, so that the filament again returns to its steel gray color, and the candle power to that normal for a treated surface.

Have I fully illustrated this point? A lamp of given candle power at a calculated voltage, which has had its filament lightly blackened on the pumps will give its candle power at a voltage higher than that calculated, because the blackened surface of this filament radiates the heat much more rapidly than the normal gray treated surface, and consequently does not get hot enough at its intended voltage when measured initially, but after several hours this black, sooty coating has been radiated to the bulb, and the filament returns to its normal color. We have, then, a lamp of lower voltage, and normal characteristics operating upon circuits where the voltage may be one, two or more volts greater than that necessary to produce the determined candles at the proper w. p. c.

The appearance of a lamp, whether it be bright or dim, is governed by the temperature of the filament, which is measured (speaking roughly) by the w. p. c. This has much to do with the light and shade in the illumination of an apartment, a show case, or window. This, of course, if the difference in w. p. c., not between the initial and final, but between the maximum and minimum in any part of the life. That this argument is perfectly logical will be seen when it is followed to its legitimate end. The distribution of illumination throughout any apartment is good or poor, in proportion to the difference in quantity and quality of illumination or areas which come under the eye at the same, or nearly the same time. This argues in favor of the concealing of the source of light, a method of illumination which has been found so effective for stage purposes. A great difference in brilliancy should not be

apparent to the eye, as the eye apparently adjusts itself to the most brilliantly lighted spot, and others are darker in comparison. It is the old difficulty of looking toward a brilliant spot of light, and attempting to outline objects near it.

It is very difficult for even a lamp expert to see the difference between a 20 c. p. and a 16 c. p. lamp if both lamps are operating at the same watts per candle. The greater the surface of the filament, however, that is, the higher the candles, the brighter the lamp looks at the same w. p. c., but this same difference is not so great that an essential difference will be noticed between a 20 and a 16 c. p. A 16 c. p. lamp delivering its 16 c. p. at 3.1 w. p. c., beside a 20 c. p. lamp, delivering its candles at the same efficiency, would not attract notice. If this 20 c. p. lamp had dropped to 16 candles, without changing in total wattage, thereby delivering its 16 candles, as it actually would in practice, at about 3.6 w. p. c., the difference in candle power would be immediately apparent to the consumer. The difference in the quality of the light delivered by the two lamps is what would have called this to his attention.

The color of the light delivered by the two lamps differs widely. The candle illumination, as determined by the photometer, may be 16 c. p. The effective illumination from the standpoint of the individual is a vastly different thing, and is not capable of being measured.

To illustrate. We have here two lamps, one of which is delivering candle power at 3.1 watts, the other delivering candle power at the same total wattage, it being a lamp which has burned a long time, and has dropped to candle power. We have here another group of two lamps delivering different candle powers from the above, but the same, that is 3.1 w. p. c. We think this will make the distinction between w. p. c. very clear.

The general opinion is unmistakably in favor of this view. The light from a number of lamps of widely varying candles or of the same candles of even slightly varying efficiencies grouped together is painful to the eyes, and in a manner not wholly appreciated, grates upon the feelings of those who have occasion to make use of the illumination. Of course, when the source of light is not apparent, the objects illuminated, if of different colors, reflect only a portion of the rays from the light spectrum, because of their color-selective quality, and therefore lamps of varying brilliancy may be used without the painful inconvenience which would result from the naked lamps being exposed to view.

It is being more generally appreciated to-day than ever, that there must not be a variation in the apparent efficiency of lamps side by side. That is, some must not be bright and others dim.

I say "apparent efficiency" advisedly. A 10 c. p. lamp appears to be of slightly less efficiency than a 20, even when it is of the same efficiency. To procure perfect satisfactory illumination, for instance, with the source of light in range of the vision, 100 c. p. lamps at 3.6 w. p. c. give better satisfaction if when used with smaller units, the latter are burning at higher economy, say 3.1 watts.

Blackening of the lamp bulb is responsible for very little of the drop in candle power. The increase in area of the filament surface is responsible for most of it. The blackening is indicative of the service a lamp has given, if its characteristics are known. Blackening is largely, if not wholly, a chemical effect, but the lamp which rises higher must always blacken more when compared with a lamp which does not rise in candles. We do not want black lamp bulbs any more than we do bright and dim lamps.

Almost every lamp rises in candles. Choose the lamp which rises least, and discount even that rise.

To sum up: Lamps do rise in candles. Everything is being done to obviate this rise and eventually it will be entirely avoided. We have not come to this yet, but we are nearer than ever before.

Decreasing the rise will do as much to maintain the uniformity of illumination as decreasing the fall of candles.

Bright lamps and dim lamps are equally objectionable, and it is my hope that I have made very plain what I started out to show, viz., that the most important consideration in determining from life tests the best available lamp for central station use, is that the true initial candles of a lamp under test be properly determined. They in my judgment are the maximum reached.

MISCELLANEOUS

Electric Smelting at Sault Ste. Marie.[1]

BY WILLIAM SMITH HORRY.

AFTER calling attention to the manner in which ore was formerly smelted, bringing out the point that only about half the intensity of the heat can be attained by ordinary combustion that could be obtained with the electric furnace, and that in smelting by combustion it is impossible to take advantage of the full heat of the fuel, because it has got to be sent out in a state not fully oxidized, Mr. Holly continued as follows:

There is not much hope for improvements in the regenerative furnaces that will make it possible to attain, even approximately, the degree of heat that can be developed by electricity, and even if the gas or oil furnaces were so designed that a high intensity of heat could be developed there is still the difficulty that no crucible would stand it, as all substances otherwise suitable for crucibles are in a liquid or gaseous state at this temperature. But with the heat developed in the interior of a vessel by electricity this difficulty does not apply. Thus we see molten masses of carbide of calcium weighing a ton or more at probably 3000° C. contained in a cast iron receptacle that would be melted if it reached a heat of 1100° C.

Another merit of this method of smelting lies in the fact that the temperature is easily under control. All processes require a precise degree of heat at which they are carried on most advantageously. In gas making and several other cases the heat is judged by its color; in any case it is judged and rarely measured. But in the electric furnace the heat can be indicated very accurately by the wattmeter, so that results, once attained in this apparatus, can always be duplicated with ease.

At Sault Ste. Marie we obtained from some of the mines at Sudbury, Ontario, a sulphide nickel ore containing generally about 3 per cent. of nickel. Its general composition is, sulphur 42 per cent., combined with iron, nickel and silica. It was proposed to experiment on this ore, extracting the sulphur to be used as sulphuric acid in paper making. The ore was roasted in a specially designed regenerative furnace, and a purple matter was produced, still, however, containing 7 per cent. of sulphur. Had this process of roasting continued longer the sulphur would have been all reduced in time, but after a certain point is reached it is a pure waste of fuel to continue the roasting process.

The matter was now ground up and mixed with lime and carbon as reducing agents, and the whole composition was served into an electric furnace. After fusing, the resultant metal was found to contain only 2-100 per cent. of copper. The alternating current only was used. I am informed by metallurgists that this practical elimination of the sulphur is gratifying, and that the use of the electric furnace here is an improvement, as it performs the service cheaply that can only be done expensively in other ways. Two types of electric furnace were used and the results we obtained from them differed widely. One was a crucible serving as one electrode, with a carbon pencil movable perpendicularly as the other pole. This pencil was drawn up as the melting proceeded and as more mixture was added; then, when the crucible was full the current was shut off and it was allowed to cool. On removing the contents of this crucible a brilliant lump of metal was found at the bottom of the pot. This was analyzed and found to contain 40 per cent. nickel, 28 per cent. iron, 12 per cent. carbon, 15 per cent. silicious matter, no sulphur, and 15 per cent. as yet undetermined. There was also found much iron in the charge, all containing nickel. There was slag, too, of course, and some unreduced composition. It will be noticed that the nickel had separated from the iron, and in subsequent experiments with larger charges this effect was more marked, so that it seems highly probable that nickel in a fair state of purity can be obtained in this way by this process.

The second furnace we employed was continuous in principle. There were two electrodes side by side with a bridge between them, the reduced metal running out of the sides as fast as it

[1]Abstract of paper read before the convention of the N. W. E. Assoc June, 1898.

was formed. In this furnace we found indications of very rapid smelting, the mixture of ore being reduced as fast as one man could shovel it in, the metal in the meantime pouring out of the sides. The iron from this furnace contained 7 per cent of nickel and was high in carbon. It is very slightly magnetic, and when cast it is found to be 40 per cent. stronger than cast-iron. It is so hard that it can be used as a cutting tool in a lathe and cuts rough iron castings with ease.

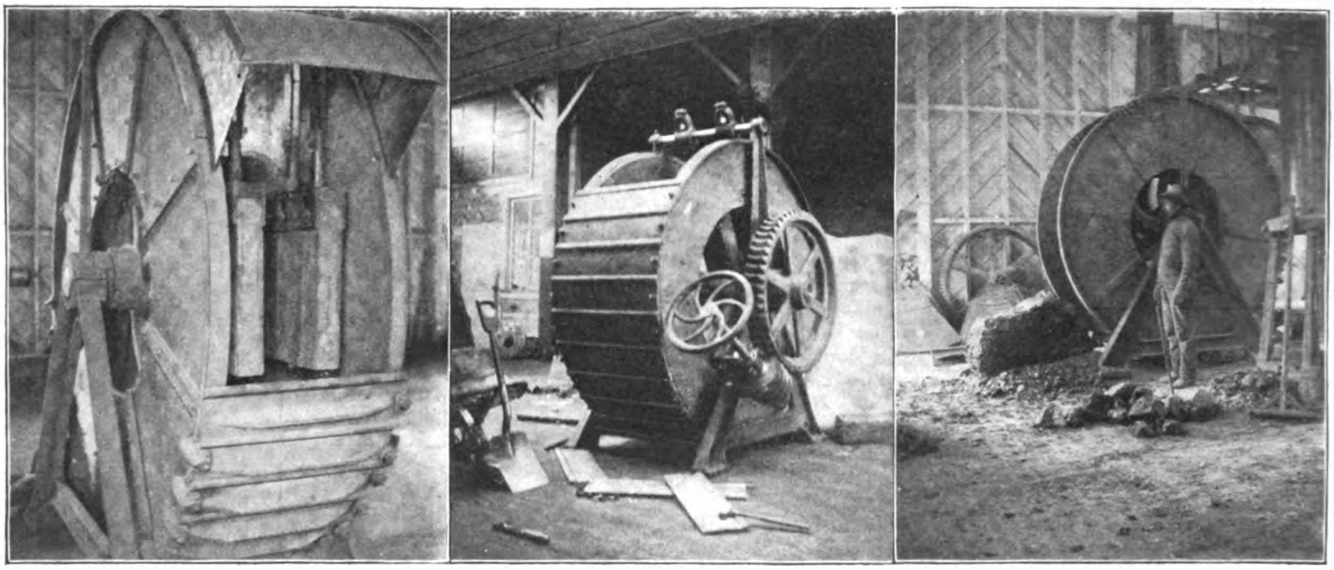
The smelting of the carbides has for some time been placed on a firm basis and as now carried on is an exceedingly easy process. There have been no changes lately in the methods announced five years ago, but the apparatus employed has been improved, and continuous furnaces are now almost exclusively employed. As our carbide furnaces are to be used in the future for the smelting of ores, a short description of them may not be out of place. They are large, cast-iron drums and resemble a spool upon which cables are wound. On the two outside peripheries iron plates can be clamped at will, and these serve to keep in the ores to be reduced. The drum is mounted on a shaft and can be slowly rotated by suitable gears.

The electrodes are carbons fixed side by side, their points touching an imaginary line drawn horizontally through the axis of the furnace. The heat due to the resistance of the ores is developed between these two points—as the ore is reduced the resultant metal lowers the resistance of the furnace and the ampere meter rises. When this occurs the furnace is slowly rotated and by this movement the metal is drawn down, away from the electrodes, and fresh ore is also brought between them to be acted on in like manner. Plates are affixed to the periphery of the furnace to keep the mixture in. The reduced ore cools within the furnace and can be extracted cold at the other side of the drum after removing the plates. At Niagara a 500 h. p. furnace of this type is now being erected. It is making calcium carbide, and will take alternating current at 220 volts potential. It stands 15 feet high. The separation of metals is entirely feasible in this furnace, because they cool undisturbed while the smelting of fresh ore continues. We have not found this effect at all in furnaces that tap out the metal as it is formed.

The adjustment of this furnace is to be automatic, a small motor controlled by an ammeter rotating the drum and keeping the current constant.

Taking it altogether, investigation in the electric smelting of ores is by no means simple. It requires skill in the manipulation of large currents, coupled with an intimate knowledge of the best practice in metallurgical operations and a thorough acquaintance with their chemistry—three accomplishments rarely found at the present time in one man.

If the heat is not right or if your proportions of reducing agents are not correct, or if some additional chemical action takes place other than the one you are expecting, it is sometimes difficult to ascertain precisely where the fault lies and where to apply the remedy, the more especially if all these faults occur at the same time. But an effect, once produced, however slight it may appear to be, can invariably be elaborated by applying known principles, and there is in consequence every reason to expect great things from the electrical method of smelting.



The electrodes and the opening into which the mixture is fed. Furnace showing the gearing by which it is rotated. Furnace showing 1,000 pounds of carbide just extracted.

THE HORRY PROCESS OF MAKING CALCIUM CARBIDE.

Transformer Regulation.

BY A. R. EVEREST.

THE "regulation drop" in a transformer is a drop in voltage at the secondary terminals of the transformer when delivering current, due to internal losses in the transformer itself, the primary voltage remaining constant.

Apparently the easiest way to determine the regulation of a transformer would be by direct measurement of the voltage at the secondary terminals; first, when the transformer is carrying no load, and secondly, when the transformer is carrying full load, the difference between the two being the regulation drop, provided the primary voltage is kept constant.

In practice, however, this test is attended with a number of difficulties, so great, in fact, as to render the test perhaps the most difficult and unsatisfactory of all transformer tests. Even when the voltage on the primary side is observed by an independent voltmeter (and step-down transformer) it may frequently happen that the temperature co-efficients of the two voltmeters are not alike, producing discrepancies in the readings, which, in themselves small, produce a large percentage error in the quantity to be finally determined.

Absolutely steady readings are also desirable for the success of this test, a condition which is very seldom attained. The pulsations of a slow-speed engine reflected on the voltmeter needle are often sufficient to make the test absolutely worthless.

There are several other minor factors which tend to disturb this test. Most of them can be met independently, as by exchanging voltmeters between readings, by taking large numbers of readings at each point and averaging results; and so on, but experience continually shows that with the greatest care the results obtained by this method cannot always be relied upon.

Perhaps the hardest point of all in connection with the regulation test as commonly made is the difficulty of persuading the station electrician who makes his own tests that his results, often absurd, are open to question. But since the losses creating the "regulation drop" in a transformer can be independently measured, the calculation of the regulation from these observed losses becomes a simple matter.

The "regulation drop" in a transformer is caused by two

losses. First, the energy loss, or CR. drop in the transformer windings, secondly, the reactive drop, or "inductance" of the transformer. In certain special cases we must also take into consideration the effect of the magnetizing current in the primary, since when the latter is relatively large it produces a phase displacement between the primary and secondary currents and has the same effect on regulation as an increase in the reactive drop.

When this phase displacement is so small as to be insignificant, the calculation of the drop of the transformer is reduced to the resolution of a right-angle triangle. We draw for the base line the total energy drop, including that in the transformer and in the external circuit.

Perpendicular to this is laid off a line representing the reactive drop in the transformer. (We are here assuming that the external load is non-inductive.) The hypothenuse joining these two sides of the triangle now represents the primary applied voltage. We may call this 100 per cent.

If the reactive drop is, say 3 per cent., the horizontal becomes the square root of 100^2 minus 3^2, or roughly, 99 per cent. If the known CR. drop in the transformer amounts to 2.2 per cent., we have left 97 per cent. voltage, (= 99.2 per cent. — 2.2 per cent.) at the secondary terminals, as compared with the primary input, or, in other words, there is 3 per cent. regulation drop in the transformer.

In many cases, however, especially when testing an unknown transformer, it is necessary to take into account the effect of magnetizing current. The calculation is then not quite so sim-

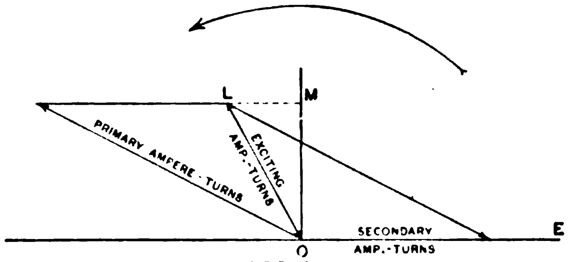


FIG. 1.

ple, but by means of the method shown below the determination can be made with the greatest accuracy. This method has the advantage of appealing directly to the eye by means of the well-known "transformer diagram."

Fig. 1 shows the relative directions of secondary current, primary current, and resultant magnetizing force and flux. O L is the primary exciting current at no load. It consists of two components, O M the true magnetizing component in phase with the flux O M, and M L, at right angles to this, which is the energy component representing the energy expended in core loss. When the secondary circuit is closed the primary current will adjust itself in magnitude and direction so as to maintain the vector O L as resultant of primary and secondary magnetizing forces.

The magnetic flux O M generates in the transformer windings a voltage O E, 90 degs. behind the flux in phase. This is the active voltage of the secondary circuit, and also appears as a counter e. m. f. in the primary circuit, where it is shown as O I. (Fig. 2.) It is here assumed that the secondary circuit is non-inductive, hence the secondary current is in phase with the induced e. m. f., O E. (For simplicity we also assume that the transformer has a 1:1 ratio.)

The voltage impressed on the primary to maintain the secondary current must be the resultant of three components (Fig. 2), namely, I O, opposing counter e. m. f. 90 degs. ahead of flux O M; D I, overcoming primary; C R, drop in phase with primary current; R D, opposing reactive drop, and 90 degs. ahead of primary current. The resultant of these is O R, which is primary impressed voltage.

It will be noted that this primary voltage O R is really the resultant of two values R I the primary impedance drop, and I O the secondary induced e. m. f. If we can calculate these, and know the secondary C R, we have the regulation at once.

It will be observed that any increase in magnetizing component increases the lag between primary current O P and counter e. m. f. O I. Since the base line I O of primary impedance triangle (the C R drop) must be always parallel to O P (the primary current) it follows that an increase in magnetizing component will swing the primary impedance vector I R more into phase with the secondary induced volts I O, increasing the value of the primary impressed voltage O R for any given secondary voltage.

If the diagram is plotted on squared paper with sufficient accuracy the regulation can be obtained at once from Fig. 2, since

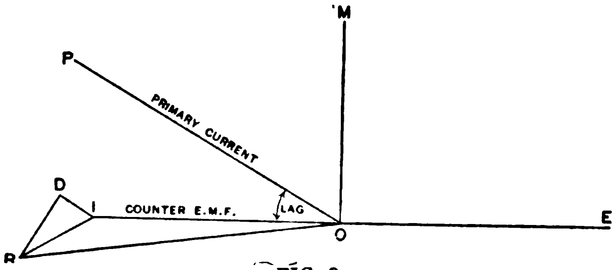


FIG. 2.

when O R is primary impressed voltage, O I is to same scale secondary induced voltage, and may be expressed in per cent. of the former. Deducting the secondary C R drop in per cent., we have the percentage of primary voltage appearing at secondary terminals.

But for greater accuracy it is preferable to calculate the side of the diagram. Let in Fig. 3 the vectors I D and D R be replaced by I J and J R, the vector of primary impedance I R remaining unchanged.

From the known values of primary impedance, C R and reactance, the angle of the impedance triangle is known. The corresponding angle J I R = β of the new triangle is equal to a reduced by the small angle J I D. But this latter angle is the angle of lag between primary current and counter e. m. f. and is readily found from the known values of exciting and full load current. (A tabulation of the lag angle for values of exciting current from 5 per cent. to 20 per cent. is given further on.)

Having found the new angle β and knowing the value of primary impedance, the new vector J R (which we may call equivalent reactive drop) is found as the sine of the angle β and the vector I J (or equivalent primary C R) is the cosine of the same angle.

Having expressed all the values in per cent. of primary voltage for convenience, we now resolve the right angle triangle O R J, taking O R = 100 per cent., R J = equivalent reactance drop per cent., and obtain O J, which is secondary terminal volts per cent. + sec. C R per cent. + prim. equiv. C R per cent. Knowing the last two values, we at once have the per cent. of primary voltage appearing at secondary terminals, and therefore the regulation of the transformer.

As an illustration, the method will be applied to the determination of regulation drop at full load of a transformer on which the following measurements are known. (The measurements of cop-

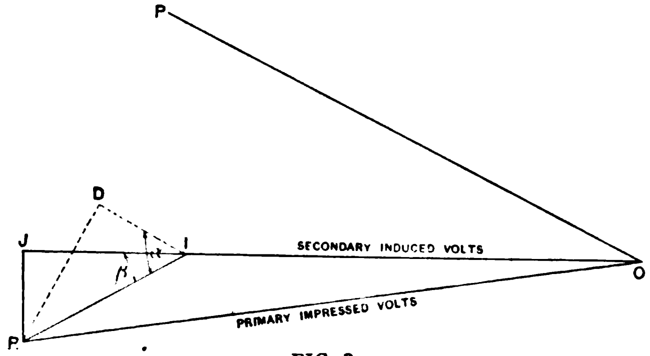


FIG. 3.

per loss and impedance drop are made by means of a wattmeter, the secondary of the transformer being short circuited, as described in Dr. Bedell's paper on transformer regulation.

Capacity of transformer, 2,500 watts; ratio of transformation, 10:1; primary voltage, 1,000—frequency, 125 cycles; copper loss (C^2R), 50 watts; C. R. drop, 2 per cent.; impedance drop, 54 volts = 5.4 per cent.; iron loss, 60 watts; exciting current (no load current in primary at 1,000 volts), .125 amperes.

The lag angle of primary current behind counter e. m. f. line is determined from the relative values of primary exciting current, and primary full load current. For convenience, the lag angles are tabulated below for values of exciting current from

5 per cent. to 20 per cent. on the assumption that the magnetizing component is 80 per cent. of the exciting current. This is sufficiently accurate for all ordinary transformers on frequencies of 50 cycles and above. The value increases, tending toward 100 per cent. with the large exciting currents accompanying very low frequencies.

TABLE OF PRIMARY CURRENT LAG.

Per cent. exciting current.	Angle of lag.
5 per cent.	2. degs.
8 per cent.	3.5 degs.
10 per cent.	4.5 degs.
12 per cent.	5 degs.
14 per cent.	6 degs.
16 per cent.	6.5 degs.
18 per cent.	7.5 degs.
20 per cent.	8 degs.

This table is not correct for frequencies below 50 cycles.

In the case under consideration we have exciting current 5 per cent., lag angle, 2 degs. The total impedance drop is 5.4 per cent., the CR. drop 2 per cent. and reacitve drop $\sqrt{5.4^2 - 2^2} = 5$ per cent.

The primary impedance drop is the resultant of reactive drop and primary CR. drop, which we may take as one-half of the total C R drop. It is therefore $\sqrt{5^2 - 1^2} = 5.1$ per cent.

In Fig. 2 we then have I R = 5.1 per cent.; I D = 1 per cent.; D R = 5 per cent. To find the angle R I D we find what angle has its sine (R D) = $\frac{5}{5.1} = .981$. The angle is 7 9degs. (See angle α Fig. 3.) Deducting from this the current lag angle we have for the angle β 77 degs. J R is the sine of this new angle and is $.974 \times 5.1 = 4.96$ per cent. Similarly J I is the cosine of 77 degs., and is in value, $.225 \times 5.1 = 1.15$ per cent.

To determine the regulation we now resolve the right triangle R O J. R O = 100 per cent.; R J = 4.96 per cent.; J O = $\sqrt{100^2 - 4.96^2} = 99.87$ per cent.

Deducting J I = 1.15 per cent., we have 98.72 per cent. as secondary induced voltage (I O), and deducting again secondary C R drop of 1 per cent. we have 97.72 per cent. of primary applied voltage appearing at the secondary terminals, or a regulation drop of 2.28 per cent.

It is of interest to note here that figuring the regulation of this transformer by the simpler method first described, entirely ignoring the effect of exciting current, the result gives 2.13 per cent. regulation drop, a difference of 0.15 per cent., due to 5 per cent. exciting current. With a larger reactive drop in the transformer, other losses being equal, the difference between results obtained by the two methods would be somewhat greater.

Calculated by Dr. Bedell's method, before referred to, the regulation drop obtained is 2.44 per cent., slightly higher than that by the method above. This is due to the fact that Dr. Bedell's method assumes that the magnetizing current is equal to the exciting current, which is not the case, and also in a slight degree to some other minor approximations adopted in the construction of his diagram.

The percentages of iron loss and exciting current taken in the above illustration are higher than would be found in good modern transformers of any but the smallest sizes, but they have been purposely taken here to illustrate the point under discussion. For the same reason the diagrams are greatly exaggerated. In actual practice the primary current line O P is very nearly parallel with the line O I.

OBITUARY

Stanley S. Stout.

Stanley S. Stout died in Chicago on June 19 after a short illness. Mr. Stout was a patent lawyer and began his career as an examiner in the United States Patent Office. During recent years his practice had been largely in the field of telephone litigation and he had made a large circle of acquaintances in the electrical field.

MECHANICAL

Mechanical Draft.[1]

BY WALTER B. SNOW.

THE substitution of the fan for the chimney as a means of draft production marks a distinct advance in the convenience and economy of steam generation. It is, therefore, fair to assume that a discussion of mechanical draft must be of particular interest to all who are concerned in central station management. Although the advantages of many improvements are to be viewed solely in their direct commercial relation, such is not the case with mechanical draft. Not only does its application insure an evident economic gain, but in both its installation and operation there are certain conveniences which are to be considered as distinct advantages although it may be almost impossible to determine their definite economic values.

Mechanical draft may, in stationary practice, be applied in either of two ways: First, by forcing the air into a closed ashpit, and maintaining therein a pressure in excess of the atmosphere, and second, by exhausting the air and gases from the flue or uptake and thereby creating a partial vacuum which causes a constant inward flow of air in the combustion chamber. The former is designated as "forced draft" and the latter as "induced draft." Under certain conditions a combination of the two methods may be found desirable. The natural result of the application of a centrifugal fan in either manner is to render the draft conditions positive at all times. A fan of the disc or propeller type is entirely inadequate for such work.

On the erection of a chimney the first matter to receive consideration is the foundation. This always represents a comparatively large, and in the case of unstable ground, an abnormally excessive proportion of the expense of the entire structure. A fan on the other hand, is relatively light, requires no expensive foundation, and may in many cases be located upon the top of the boilers. Not only does this vastly reduce the cost of installation, but it furthermore lessens the space required, which is always a definite character in the case of the chimney, but with a fan placed overhead is entirely eliminated.

The portable character of a mechanical draft apparatus renders it not only valuable as an available asset, when it is no longer required in a given location, but makes possible its relocation or arrangement in a manner that is absolutely impossible in the case of a chimney, which must always stand as a monument to a departed industry or an abandoned means of draft production.

The primary duty of the chimney is to create sufficient draft, while its secondary office is to remove the gases and smoke to a proper height for discharge to the atmosphere. The height required for this purpose is almost universally less than that necessary to produce the draft. Obviously, a stack of decreased height and cost will serve the purpose with mechanical draft. In fact, a sheet iron pipe extending but a few feet above the top of the boiler house will in most cases fulfill the requirements.

The steel plate construction which is common to most fans employed for producing draft makes it possible to readily design and build them to exactly suit any given conditions. Such a fan may be arranged to be driven by a belt or by a direct connected engine, as may be desired, may be automatically controlled in its speed to meet the requirements of steam generation, and may be increased in capacity by the simple transmission of more power.

In operation, mechanical draft is both positive and flexible. Its positive character renders its action independent of the weather and its flexibility lends to it that characteristic so lacking in the chimney, the ability to exactly adapt the intensity of the draft as well as the volume of air to the existing requirements. How much those two elements of simple convenience mean in the generation of steam for electric traction work can only be realized by one who has experienced the sudden and immense fluctuations incident to such service. The fan is always at its best, can be instantaneously pushed to its utmost and does not have to wait for hotter fire to produce stronger

[1] Abstract of a paper read before the N. W. Elec. Assoc., June, 1898.

draft. When properly installed, such a fan should be provided with an engine devoted solely to its driving, and the speed of this engine should be so controlled by devices that are readily applied, as to increase its speed in proportion as the steam pressure falls. It is thus possible under all ordinary conditions to maintain practically constant steam pressure and to insure immediate response to sudden demands.

Another feature of convenience resulting from the employment of mechanical draft is to be found in the ability to burn cheap fuels which are almost invariably of small size and require an intensity of draft which is not readily created by means of a chimney. The economic value of this and the preceding features of convenience will be considered as we proceed.

The "smoke nuisance" is in many of our communities receiving the attention that it properly deserves. In practically all devices which have proved successful in the prevention of smoke, improved draft has been a most important factor and the positiveness and intensity of the draft produced by a fan have assured the success, which has attended its application.

We may now turn to the distinctly economic aspects of the installation of mechanical draft and of necessity these must be considered relatively to those incident to the use of a chimney. Employed solely as a means of creating air movement, the chimney is most absurdly inefficient. It may be readily shown that under the ordinary conditions of boiler practice an engine driven fan will move a given amount of air with the expenditure of about one seventy-fifth as much power. This immense advantage of the fan over the chimney may be turned to good account by introducing proper devices for transferring the heat of the gases to the feed-water or to the air supplied to the fire, and the gases may, with fan draft, be cooled to a temperature far below that which could be attained with a chimney without too seriously reducing its draft.

Custom and the expense of high chimneys are, doubtless, responsible for the comparatively low combustion rates which prevail in most steam plants. It may be fairly stated that to double the rate of combustion on a given grate area, it is necessary to make the chimney about three times as high, at a cost, perhaps, five times as great. In the case of a fan the same result could be obtained without even so much as doubling the cost.

Low combustion and evaporation rates are not essential to high efficiency. Within reasonable limits the higher the rate of combustion, the less is the volume of air required per pound of coal. The fire is of necessity deeper, the draft is stronger, and each individual particle of air has increased opportunity to come in contact with the fuel. With a decreased supply of air the intensity of the fire is increased, its temperature is higher, more heat is radiated to the exposed boiler surfaces and more is taken up by the gases, which, because of less ultimate volume, move at lower velocity and thus have more time to part with their heat.

When a fan is employed as a means of draft production it may, at comparatively small expense, be installed of such size as to possess a potential capacity which if embodied in the boilers could only be provided at vastly greater first cost with incident larger fixed charges.

The power expenditure for operating the fans should be practically inappreciable in any well designed plant in which provision is made to utilize tne exhaust steam from the fan engine.

The most direct saving in operating expense, which may be secured by the introduction of mechanical draft, is that resulting from the utilization of cheaper fuel. Such a plant as previously described would, under good conditions, probably, require at least 8,000 tons of high grade coal per year, operating ten hours per day. If a saving of only 25 cents per ton could be effected it would represent an aggregate of $2,000 per year, a pretty good return on an investment of $3,500. But in many cases much greater savings may be brought about. A case in point is that of the United States Cotton Company at Central Falls, R. I., where, with a 1,000 horse power boiler plant, the fuel originally employed chimney draft was George's Creek, Cumberland, costing $4 per ton. With forced draft, a mixture of No. 2 buckwheat screenings and Cumberland is now used, costing $2.62 per ton. The saving has been about $125 per week, enough to pay for the special steam fan in about six weeks.

Other direct and indirect advantages of mechanical draft might be presented, but the limits of the paper will not permit. If it were not for its rough and ready character, the chimney would long ago have been discarded, because of its wastefulness. In the search for the highest efficiency such waste can no longer be ignored and when dollars and cents are concerned, crude methods must give way to those of greater refinement. It is for this reason that the most progressive engineers of the present day are not only considering, but adopting mechanical draft as a substitute for the chimney.

In the discussion which followed the reading of this paper, Mr. Doherty pointed out the saving effected by the use of electrically driven feed pumps. He also referred to electrically driven fans for creating the mechanical draft and said that the latter must be crowded in order to give efficient service. He also discussed the relative economy in the use of economizers and recuperators, and he declared himself to be rather in favor of the latter. He commented highly on Mr. Snow's reference to the prevention of the smoke nuisance by the use of mechanical draft.

Mr. Dow made a few remarks about the advantages of using a thick layer of fuel rather than a thin one, as the former produces the appearance of carbonic oxide and reduces the amount of air enormously. These arguments were refuted by Mr. Doherty, who stated that he has seen thin beds produce considerable carbonic oxide and at the same time a large quantity of free oxygen.

Mr. Cross, the reader of the paper, in the absence of the author, closed the discussion by expressing the opinion that mechanical draft, economizers and automatic stokers might be all right for large central stations, but small stations could make steam just as cheap without any of them, if you count in the interest charges on the extra investment. He believed however, that mechanical draft might decrease the investment.

"Crypton"—Another New Element.

A SPECIAL dispatch from London of June 6, says: Professor Ramsay, the joint discoverer with Lord Rayleigh of argon, has, with the assistance of Morris Travers, eliminated from the atmosphere a new gas, which he calls crypton. The new element is obtained by evaporating large quantities of liquid air. It is transparent and heavier than argon, and like the latter is inactive. It exists in the atmosphere in the proportion of one to 20,000. Its chief lines in the spectrum are green and yellow. The latter is nearly coincident with the helium yellow line, D3.

M. Berthelot has read to the Academy of Sciences, in Paris, a communication from Prof. Ramsay in reference to crypton, from which it was learned that the discovery, like that of argon, was made by the spectroscope.

The discoverers received from Dr. Hampson 750 cubic centimetres of liquid air, which they reduced by evaporation and collected in a tube. A gas was furnished by the residue. This gas was deprived of its oxygen by the help of metallic copper, and of its nitrogen by the action of the electric spark, and of its oxygen after that by a mixture of magnesium and pure lime. This effected, there remained 26 cubic centimetres of gas, which presented, besides a weakly defined spectrum of argon, an additional spectrum till then unknown. It was characterized by exceedingly brilliant lines, one almost identical with D3. The other green line may be compared in intensity with the green line of helium. Its wave length was 5566.3. Another slightly weaker gave 5557.3. The density of the gas was approximately 22.5, that of oxygen being 16. According to the velocity of sound the ratio of specific calorics is 1.666, the same as that of argon and helium. It therefore follows that the new gas is monatomic and constitutes an element.

These facts go to prove that the atmosphere contains a hitherto unknown gas heavier than argon and with a characteristic spectrum less volatile than nitrogen and oxygen and argon. Prof. Ramsay was unable to absolutely determine its position in the periodical. He, however, hazards the conjecture that the pure gas has a density of 40 and an atomic weight of 80, and that it may be classed with helium. The investigations are being continued, and a larger quantity of the gas is being prepared. M. Berthelot, who received a small supply of the new gas in a Fluckyer tube, has verified the existence of new lines by the spectroscope.

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Mechanical Draft and Boiler Room Economy.

WHEN one considers the multiplicity of apparatus in a modern central station other than that used for the transformation of mechanical energy into electrical and for the distribution of the latter, and compares their relative efficiencies, it is not at all surprising, but seems rather imperative, that central station men, in convention assembled, should turn their minds to the discussion of steam making and steam using appliances. It is an encouraging sign to see the societies composed of central station men include in their list of papers several dealing with problems other than electrical and which so seriously affect the economy of a central station. One of these is the subject of mechanical draft, on which a very able paper was read by Mr. Walter B. Snow at the convention of the Northwestern Electrical Association and an abstract of which appears on another page. The employment of mechanical draft is one of the many perplexing "improvements" which have as many opponents to depreciate their value as they have advocates to laud their advantages. It is a problem dependent largely upon local conditions, and may be shown to possess advantages when installed at the time a station is built, while it may become a material disadvantage financially and a source of trouble when installed in a central station already giving good results. There are two general methods by which mechanical draft can be secured, namely, the aspirating principle, in which a rapid motion is given to the air to draw it out of the smoke-box, so that the reduction of pressure within the latter shall cause a flow through the grates, fire and tubes to equalize this rarefaction, and secondly, the forced draft-system, in which a pressure of air is caused in the ash pit below the grate bars, so that the air will flow up through the fire, the setting and flues by the excess of pressure which prevails in the ash pit. Since combustion is more efficient, the denser the air is used to effect it, the pressure system seems to offer an advantage from this point of view.

In answer to the question which has been raised as to whether the employment of mechanical draft may in time do away with the chimney, it should be remembered that when the chimney is once built and paid for the draft machine costs nothing to run except the heat which is used for this purpose, and it undergoes little or no deterioration with use. Furthermore, in cities, the necessities imposed upon the power plant to carry the products of combustion high enough up to create no nuisance in its neighborhood compel a height and cost of chimney which make the consideration of mechanical draft unnecessary, since the high chimney must be there in any case. Again, where the plant is so large that the cost of the draft machine becomes considerable, or what is the same thing, the cost of the expensive chimney becomes distributed over a large number of horse power units, the advantages of mechanical draft are not so apparent. It offers, on the other hand, according to Prof. F. R. Hutton, the following distinct advantages: (1) The rapidity of combustion in the fire box is not limited by atmospheric conditions, (2) it is possible to increase the evaporative capacity of a given plant without other change than the velocity of the draft-machine, (3) it is possible to burn inferior, cheaper and smaller sizes of fuel with mechanical draft, because a high pressure can be maintained which will force the necessary air through a compact body of fuel, (4) where high stacks are not made necessary the cost which they entail is avoided, or is offset by a less cost of the draft-machine. The objections to be raised against mechanical draft are: (1) The running cost of the machine, including fuel, repairs and supervision, (2) the machine occupies space which can often be ill spared, (3) running machinery, and particularly that at high speed, such as most draft appliances demand, is rarely silent, is often noisy and is liable to breakdowns which compel it to stop. To weigh these advantages and objections against each other and include in the discrimination the local conditions which will affect the decision is the serious problem with which the central station designer and manager has to deal. In making this decision, however, he should not lose sight of the fact that he may overburden his station with labor-saving devices which if not properly handled and carefully watched may become the most dangerous fuel-consuming devices in his plant. He may place his engineer in the position of the unfortunate wife who was compelled to get divorced from her husband because he insisted on having every new domestic mechanical appliance used in his household for every conceivable purpose. If the managers of central stations would look more to the correct handling of their simple apparatus and see that the engineer and fireman perform their functions efficiently, perhaps there would be no need for the recent statement by the Mutual Boiler Insurance Company that, through bad shoveling nearly $2,000,000 worth of fuel is wasted yearly in the boilers under their control. Let them pay attention to this, and to the economical purchase of the right kind of coal; let them prevent their steam from escaping through leaky joints or their heat being wasted by poorly covered pipes, and they will discover in their boiler-room the truth of the words that "Trifles make perfection, and perfection is no trifle."

Aluminum as an Electrode in Cells for Direct and Alternating Currents.

THE above topic formed the subject of a very interesting investigation undertaken by Mr. E. Wilson, the results of which have been communicated to the Royal Society by Dr. J. Hopkinson. The paper deals with the apparent great resistance which aluminum offers to the passage of an electric current when used as an anode in cells containing, for instance, such an electrolyte as alum in water. In the first series of experiments, with direct currents, cells having aluminum and carbon electrodes and an electrolyte of saturated alum water were employed, and a current of 3.6 amperes and 4.4 volts was passed through the cells. After some time the current was reversed, the time between reversals having been 27 minutes, and the very important point was brought out that the current, when reversal took place from 3.6 amperes, first crossed the zero and acquired an opposite sign, finally coming to zero of the instrument. The experiment was repeated with the same electrodes and an H_2SO_4 solution, with similar results, which have been carefully tabulated. Investigating the effect of temperature upon the potential for a given current, it was found that as the temperature of the cell rises from 13.5 to 70° C. the potential difference falls from 30 to 3 volts, for which the change of resistance will only partially account. It showed that the film which had been formed on the aluminum plate has a high resistance and is affected by the temperature, and that this film is more stable when the positive pole of the charging battery is connected to the aluminum. It is a well known fact, however, that a clean aluminum plate acquires this film when simply submerged in an alum solution in the presence of oxygen without the passage of currents. This film, according to an analysis made by Prof. Herbert Jackson, consists of basic aluminum sulphate.

By far the most interesting portion of the paper, and one which may lead to important commercial results is the one dealing with the effect of the alternating current on the above cells. These experiments were undertaken to investigate the instan-

taneous values of potential and current and to see if aluminum is a valuable metal for use in condensers for alternating currents. Numerous experiments with different frequencies were made, and it was found, among other things, that with the working of these cells the aluminum wears away and the electrolyte evaporates rapidly. By employing large aluminum plates opposed to each other in a saturated alum solution it was found that aluminum was well suited for plates in condensers. The author sums up his conclusions in the following manner: "The effect investigated in this paper takes time to develop, and is not fully developed with alternating currents of frequencies sixteen and ninety-eight complete periods per second. It can be increased by increasing the current density for a given film, and is greatly influenced by temperature. The metal aluminum, with its film, is suitable for use as the plates of condensers, if due regard be given to current density and temperature. It might in some cases be found useful as an equivalent to a metallic resistance." Does this not appear to be a step towards lightweight storage of electrical energy?

Power Transmission Schemes.

THERE is no dearth of power transmission schemes. If they crop up at the present rate, we don't quite see where coal will find any raison d'etre as an industrial factor, for, should all be developed, there will be current enough to run all the machinery in the country and do a little lighting and heating "on the side." The difficulty of such work no longer consists in developing the power, but in developing the customer for it, and the latter point is the one on which many of the proposed enterprises must break. Some of these schemes are away off in the wilderness, and although the power plant may in time constitute a nucleus for other work, dependent upon it, we must confess our preference for projects that already have a dense population settled within the territory of operation. This feature is what makes the Niagara plan so hopeful and tangible, for it has the big, bustling city of Buffalo well within reach and a number of other industrial centres adjacent, as well as a market just at the Falls. This consideration also is one that gives an air of reality, to say the least, to the schemes of the Ramapo Water Company, which not only seeks to furnish water from the Catskill region to the millions of people living in New York and its vicinity, but sees a large opportunity for electrical power transmission from the one thousand square miles of lofty watershed thus to be tapped.

It must be evident to any one who studies the situation that the population seated at the seaboard here must continue to strike further and further inland for its source of water supply, and may even have to tap Lake Erie. But this Catskill project may well be a feasible compromise of long duration and carry with it the generation of abundant electrical current for many years to come. Whether New York can get any of the power, whether, in fact, there would be enough to pay for bringing it here, we are not able to determine, but it is obvious that there are a number of uses and services between here and the Catskills, to all of which the current could be profitably applied, such, for example, as the operation of the West Shore Railroad and other lines through the region, as well as many industries along the Hudson River.

How to Distribute Street Lights.

THAT we have by no means reached the end of developments in street illumination is a fact that is brought to mind again by the interesting article from Mr. Henry Hopkins, which we print in this issue. His data, opinions and conclusions, as those of a highly competent and efficient city official, will receive careful attention. He makes a fine showing for the arc light, and it will be agreed with him that the arc is not liable to be superseded. We would like, however, to see his suggestion of greater subdivision of the arc carried out experimentally. The effect of the small MacIntire enclosed arcs at the recent Electrical Exhibition in this city was strikingly good and must have suggested not only the general feasibility of greater subdivision but the use of the arc in places from which its volume and intensity have hitherto debarred it. There should be no need to "chink in" with Welsbachs anywhere. As Mr. Hopkins says, "the locality should govern the system," and if a big arc light does not meet the conditions, an electric lamp of some other size that does answer should be readily available.

Motor Fans on Trains.

IN our issue of June 16 Dr. Margaret A. Cleaves made the interesting suggestion that it would be a good move on the part of railroad companies to put fan motors in their passenger cars in the summer time as a means of keeping the air fresh and pure. By a curious coincidence, the announcement is now made that the Baltimore and Ohio Southwestern Railway officials have solved the problem of cooling sleeping cars in stations at night. At Cincinnati, Louisville and St. Louis this line has sleeping cars placed in the stations at 10 p. m., which do not depart until after midnight, and in order to make them comfortable and cool it has placed 16-inch electric fans in each end of the sleepers, thus removing the heated and impure air from all parts of the car. The fans have been in operation about two weeks and have been the subject of many favorable comments from the traveling public. This is certainly a step in the right direction and a piece of judicious enterprise worthy of general imitation on all the railroads. Why should not all cars be sweetened and freshened in this way before taking on passengers? It would not be very expensive; in fact, it might more than pay for itself in the inducement thus given to ride rather than avoid, as one now does, the hot, stuffy, smelly cars that are so uninviting. Perhaps the innovation could be limited to certain cars where an extra payment is already asked. We can hardly be mistaken in supposing that it would be welcomed by a great many. Dr. Cleaves' idea of fan motors on the cars while in motion is not bad. It would enable one to close the windows that now let dust and cinders in so freely, as the fans would keep the air circulating. The coming of electricity for traction purposes will soon render all these improvements far more possible and feasible than they now are.

Battlefield Communication.

IT will be interesting to see how the present campaign in Cuba tests the utility of various means of communication on the battlefield and how far our Signal Corps has perfected its system and apparatus. We are glad to note the active recruiting that has gone on for the signal service ranks, but these new men have to be broken in, and what we are all concerned with just now is the activity in the neighborhood of Santiago de Cuba. In such a country as the eastern end of Cuba, with high mountains, dense forests and few roads, lines of communication are even more necessary than they would be in an open district of plains, and we opine there is plenty of work cut out for the Signal Service Corps. The tropical forest is not kindly disposed to aerial circuits, the tropical rainy reason is not the best for high insulation, and the demands on vigilant inspection and maintenance will be heavy. In fact, a better opportunity to dispense with wires and try the Marconi system from mountain top to mountain top could scarcely be found. There is also a good chance to test the serviceability of army balloons and even of homing pigeons, as well as searchlight signals by night—any means, in short, that will keep a commanding officer in touch with his men and informed of all that is occurring. We hope to record for General Greely, Chief Signal Officer, and for the whole corps a large amount of invaluable work.

Electricity on Steam Railroads.

ONE of the papers at the recent meeting at Saratoga Springs of the American Railway Master Mechanics' Association was by Mr. Brangs, the electrical engineer of the Delaware & Lackawanna R. R., on the subject of the application of electricity to steam railroad traction. It was an excellent review of the subject, the speaker showing himself to be in favor of main-line use of electricity, and he made the statement that a ton-mile can be operated by the electric system for less than one-half the cost for fuel, and that the total cost of electric power, including all power station expenses, would not exceed three-quarters the cost of coal for the steam locomotives. A Mr. Hibbard, of Minneapolis, in commenting on the paper, said he thought that electricity was still limited to suburban work, but added: "For suburban service I believe it is to the shame of our steam railroads that they have allowed the electric trolley companies to get ahead of us. * * * It is a shame that we have permitted the electric railways to get almost all the passenger traffic." That is a frank admission, to say the least, but the Consolidated Railroad has shown up at Hartford how the steam companies can hold their own if they adopt electrical methods, with all the increased flexibility and better service that such methods imply.

ELECTRIC TRANSPORTATION

Electric Street Railways in Baltimore, Md.—II.

BY C. B. FAIRCHILD.

THE BALTIMORE CONSOLIDATED RAILWAY COMPANY.

THIS company was formed by the union of the Baltimore Traction Company, the City and Suburban Railway Company, and other smaller companies. The aggregate trackage is about 200 miles, on which 883 cars, open and closed, are operated, with about 1,000 car employés. Mr. Nelson Perin is president, and William A. House is vice-president and general manager. All the lines are now operated by electric power, the first electric installation having been made in 1892, when four cars were put in operation. The two cable lines belonging to this system were transformed in 1896, but the old cable tracks have been retained. The tracks of the cable construction are standing up remarkably well under the heavy electric cars, showing that the original construction was exceptionally well done.

The rolling stock of the cable road was mounted on trucks and equipped for electric power. Since the change from cable to electric cars, it is estimated that the cost for operating per car mile is 25 per cent. less than by cable power. Two of the old cable power stations are idle, and some of the engines are for sale.

A variety of motors and trucks are found, owing to the different equipments on the original line. The trucks include those of the Lord-Baltimore type, manufactured by the Baltimore Car Wheel Co., and those of Brill & Bemis manufacture. The motors include the G. E. 800 type, W. P. 50's, and Westinghouse No. 3. Sixty new nine-bench open car equipments have recently been bought, which were made by the Brownell Car Co., of St. Louis. These new cars are mounted on Lord Baltimore trucks, with wheels by the same makers, and are equipped with Westinghouse No. 49 A motors.

In connection with the operating department, three trouble stations are conveniently located, which are equipped with tower wagons and wrecking tools, and are provided with an automatic signaling system.

POWER STATIONS.

There are three stations in which current is generated, having a total steam equipment of 7,350 h. p. Two of the stations are equipped with McIntosh & Seymour engines and General Electric generators, the other with Westinghouse generators and engines. The Pratt street station is the largest, and is one of the most modern and model stations of the country. The building is of brick and of ample proportion, the engine room being 192 by 84 feet, and the side walls 42 feet to the eaves, and capped with a high monitor roof.

The electrical equipments, including the generators and switchboard furnishings, are all of the General Electric manufacture, while the engines are of the McIntosh & Seymour make, and all are tandem compound condensing. The units include four belt driven machines and two direct coupled. Of the former the generators are each of 500 k. w. capacity, and the engines each of 800 h. p. The direct coupled generators are each of 800 k. w. capacity, and the engines 1,200 h. p.

The auxiliary equipment consists of a direct coupled booster of 100 k. w. capacity, which is driven by a 250 h. p. engine. This machine raises the tension on a particular line 125 volts, or to 675 volts, as the station output is under a tension of 550 volts. There is another auxiliary equipment, consisting of a small 200 k. w. railway generator, and a 100 k. w. booster, which are set tandem, and are driven by a double belt from a 250 h. p. engine.

The switchboard is of black marble, and is built half on each side of a corner angle against the station walls. The belt driven generators have the openings at the end of the main shaft bearings covered with glass; the glass is mounted in a circular brass sash, which is fastened by screws through holes drilled into the edge of the bearing. The glass prevents the dust from entering the bearings while it allows of the necessary inspection.

A peculiar feature of the large engines is a small supplementary shaft mounted in line with the main shaft, but which is driven by a drag link from the crank pin. On this shaft are mounted the eccentric rod and a small flywheel, which contains the governing mechanism. A small oil pump, operated by a pin in the end of the main shaft, serves to deliver the oil to the main bearings; the supply being taken from a tank inside the bearing pedestal. The station is equipped, however, with a home designed automatic oiling system by which the oil is supplied to all wearing contacts on all the machines except to the main bearings and the cylinders; the latter are oiled in the ordinary manner. The oiling device includes a circular air tank, which is mounted slightly above the cylinders, and which has a capacity for a 24-hour supply. From this small tank small brass pipes lead to the parts that require oiling. These tanks are filled automatically from a large boiler tank, which has a capacity for about 600 gallons, and which is located in the basement, and from which the oil is forced by air pressure. Located beside the tank is a filter, consisting of an iron vat having two compartments. The waste oil from all the machines is led by pipes to the first compartment, into which it drains through a fine mesh copper sieve. Near the surface of this tank are two rows of small steam pipes containing live steam, and which serve to raise the temperature of the oil near the surface, thus reducing the specific gravity, and causing the water and dirt to sink to the lower portion of the tank; while the clean surface oil flows over a partition into the second compartment, from which it is pumped into the storage tank.

Any supply of new oil that may be required is introduced into the second compartment of the tank. The water and waste are drawn off from the bottom of the first compartment, which is also provided with a water gauge to indicate the character of the contents. A Boyden air pump, located against the wall in the engine room, supplies the necessary pressure for forcing the oil into the auxiliary tank, and for blowing out the service pipes when necessary, and also provides an air blast for cleaning the generators. A marble stand and basin is also conveniently located in the engine room, which is provided with two faucets from one of which the cylinder oil is drawn, and from the other such machine oil as may be required for special purposes; the oil in both being under air pressure. The automatic oiling device prevents a waste of oil, permits of cleanliness about the room and leaves little work for the attendants.

In this connection it may be noted that the engineers and attendants, as well as the firemen in the boiler room, are all required to wear a uniform while on duty, which, as well as the hat, are made from white duck cloth. The regulations require that the uniforms be changed for a clean suit every Sunday morning, the theory being that if the men learn to keep themselves clean they will take more pride in keeping the machinery in fine condition.

The economic features of the boiler room are not less interesting than those in the engine room equipment. The steam is generated in five batteries of boilers, each of 750 h. p. capacity, and which are of the Campbell & Zell type, and are fed by Roney mechanical stokers; all the water and steam pipes are provided with Chapman gate valves. A coal and ash conveyor is provided, which is driven by a 20 h. p. engine, and travels in a continuous circuit beneath the ash pits, up the side walls and across beneath the roof of the building. This conveyor serves to deliver the coal to the storage tank above the boilers, and to remove the ashes and elevate them to a bin from which they are readily drawn through chutes into carts. The coal, which is George's Creek "run of mine," is delivered on scows in a slip just across the street from the station. It is elevated and crushed, and delivered into the storage tanks by the conveyor.

For firing, the coal is first drawn into a small hopper by which it is measured, and where it is moistened by a spray that is turned on as the coal flows into the hopper. The opening of the traps and the regulation of the spray is done by valves and a long lever from the floor of the fire room. Each hopper is provided with a swinging chute by means of which the coal is easily distributed to the long hoppers above the grate bars. In the process of filling these hoppers, one attendant swings the chute by means of a chain and pulley block while the other operates the trap lever. The coal being moist prevents dust, and it also causes the charge to coke on the grates, which prevents its sifting through before burning. A staff of two men is all that is required to fire all the boilers, while a third man is sometimes employed for cleaning up.

The company employs an expert chemist, whose duty it is to analyze a specimen of each scow-load of coal, and also each purchase of oil. Water for steam purposes is obtained from the city mains, while that for condensing is drawn from the slip. An artesian well, 100 feet deep, supplies water for washing floors, wetting the coal, and other purposes, but it is not sufficiently pure for steam purposes.

The station is under the direct supervision of Mr. P. O. Keilholtz, electrician and mechanical engineer, and he also has charge of the overhead construction.

REPAIR SHOPS.

The main car shop occupies a large one-story building formerly employed as a car house. The different departments are systematically arranged, and are convenient for access from one to the other. The main floor is provided with a number of pits which run the full length of the building. To the right of this are the machine shops and blacksmith shop, which are separated from each other by a partition; and to the right of these is the winding room, separated from the others by a glass partition. An electric transfer table, located on a cross track in the rear, serves to place cars on any track or in the blacksmith shop. Curves from each house track connect with the main track in front of the building.

The woodworking machinery consists of a band saw and a "Universal" woodworking machine made by M. B. Tidey, and is placed near the front of the main floor, being driven by an electric motor from shafts located under the floor. Over a portion of one of the pits an elevated track is provided, on which run four trolley hand hoists of the Yale triplex type, and so arranged that when a carbody or truck is lifted, it may be run off in either direction. The walls of the pit are of brick, and on each side is a ledge, which provides a track for an armature lifter, which can be run back and forth the length of the pit, and which is operated by a screw. One corner of the main floor is devoted to fender repairs, and two men are constantly employed on fender repairs. The fenders are of home-made design, and are made with pipe frame and rope netting, and fold and turn up against the dash. The wheel guard was also designed by the master mechanic, and is in the form of a scoop fender, so adjusted to the brake mechanism that it dips down to the paving when the brakes are applied. The fenders and guard are both efficient, and the company would continue to use them for their own protection were the ordinance requiring them abolished. There are four blacksmith forges and the tools usually found in shops of this character. A small electric motor drives the fan blower for the fires. A machine for grinding flat wheels occupies a part of the blacksmith shop, and is driven by power from the machine shops; on this machine hollow emery wheels are employed, and it is claimed that considerable saving is effected by grinding the flat wheels.

The journal boxes proper are made of cast iron, the castings being purchased from a local firm. These are finished in the machine shop and are babbited with a very thin lining of metal, which is frequently renewed. Formerly a box entirely of babbit was employed and the metal remelted when worn; but it was found that there was a limit in the number of times the material could be melted, so the cast box was substituted. These are babbited over one end also, so there is practically no wear on the box proper.

The tool equipment of the machine shop is very complete, and consists of five drill presses, five lathes, a shaper and a turret headed lathe. The largest of the drill presses has several attachments for special work, and with some of the others was manufactured by the W. F. & J. B. Barnes Co., of Rockford, Ill. There is also one drill press made by the New Haven Mfg. Co. The shop is equipped with overhead trolleys and hand hoists, together with castor trucks for the convenient handling of material. A babbitting table, with crucibles for melting the metal, and mandrils and presses for holding the journal boxes is arranged on one side of the shop, and every department is so arranged that all the work goes on under the direct inspection of the foreman. Power for operating the shop is derived from an electric motor. The winding room is equipped with the usual tools and appliances for repairing armatures, winding field coils and making commutators, and is in charge of an experienced foreman. From eight to ten hands are employed in this department.

PARKS AND PLEASURE RESORTS.

The Consolidated Company has given special attention to the development and equipment of parks as summer resorts, and now has seven delightful resorts, containing from 34 to 75 acres each, and provided with many attractions, including a scenic railway, dancing pavilions, a riding gallery, boating facilities, ball grounds, tennis courts and provision for other popular games. The largest park, and the one having the greatest natural attractions, is known as Gwynn Oak Park, which is well wooded with native oaks, and has quite a stream of water with an attractive fall, around which are arranged rustic seats; this park is about seven miles from the city, and is reached by two of the company's lines.

DISCIPLINE.

The general manager, Mr. William A. House, refers with a great deal of pride to the economy resulting from the establishment of a board of investigation, the personnel of which includes the general manager, claim agent, superintendent of transportation and the division superintendent of any line on which an accident may have occurred. All complaints and accidents are investigated by this board, and all penalties and discharges are made subject to a majority vote. Officers specially designated are furnished with written statements and such witnesses as they are able to obtain, and a fair and careful hearing is given in each case, without partiality, which insures justice being done to all parties. A report made by the general manager shows as the result of the work of the board and the rigid manner in which accident cases are investigated, that the losses from accident charges during four years following 1893 were to a remarkable degree less than for any preceding year; for instance, the decrease in 1896, as compared with 1895, was 18 per cent., and was over 32 per cent. less than in 1893, the year in which the heaviest losses occurred, although the mileage in 1896 was over 23 per cent. greater than in 1893. In engaging new men a deposit is required, on which the company allows interest. Motormen after being under instructions on a car for seven or eight days report to the master mechanic, who examines them and gives such additional instruction as they may require, with simple illustrations as to why certain regulations, as to handling the motors, are required. They then go into the machine shop for three or four days and are coached by the foreman, who reports them to the master mechanic when proficient, and they are put on the extra list.

In the purchase of supplies, the company patronizes the local dealers to a considerable extent. The wheels, as before noted, are purchased from the Baltimore Car Wheel Co.; mechanical supplies from Jno. Brown & Sons, and some of the electrical materials from the Southern Electric Co.

Trolley Rights in Connecticut.

The Connecticut Supreme Court of Errors has handed down a decision in the New Haven County case of the New York, New Haven & Hartford Railroad Company against the Fair Haven & Westville Railway in favor of the steam company. The decision acknowledges the claim of the railroad company for damages for the crossing of its tracks at grade by the trolley road on Bridge street, near Belle dock, in New Haven. The steam road secured a temporary injunction in 1894 from Judge Hall restraining the electric road from making the crossing, but the injunction was subsequently dissolved. Another injunction was obtained from Judge Wheeler and this was also dissolved. After the hearing on the facts the case went to the Supreme Court, and the decision of that court notes a difference from the general ruling that an ordinary trolley line in a street is not an additional servitude of the adjoining property-holders. Accordingly, unless the trolley road pays damages to the steam road, the latter will have the right to prevent the crossing of its tracks at grade. Since this suit was begun the Legislature has passed a law prohibiting the establishing any more grade-crossings of steam and electric roads.

AMERICAN ENGINE COMPANY, of Bound Brook, N. J., have just taken an order from the Northern Electric Company, of Baltimore, Md., for two cross compound engines, one of 350 h. p. and one of 450 h. p. The American Engine Company have just installed a 350 h. p. engine in this plant, and report themselves as otherwise very busy indeed on all classes of work.

The "X" Rays and Their Safe Application. Destruction of "X" Ray Infections by Electro Sterilization.[1]

BY J. MOUNT BLEYER, M.D., F.R., A.M.S., LL.D.

DISCOVERIES of the properties of the X-rays go on at a rapid pace and the scientific world is watching with the closest interest the experiments that are being made from their different aspects to determine the effect of these rays upon the human body. Since their discovery and their application in medico-surgical work reports soon startled and spread throughout the profession and lay public of a grave danger accompanying the use of these X-rays, owing to the fact that they produced so-called virulent burns by exposure to them.

Records now hold among their files many cases—differing in degree, and some have proved fatal from a lingering exposure to them. Even records tell us of a recent murder trial in this State in which the chief question arose—whether the physician who made this X-ray exposure upon a patient was guilty of an act of negligence from which death followed.

Let me say at the outset of my remarks, from what I gathered from my experimental work, that all your timidity in their future application can be allayed. I concluded that if the X-rays are applied under certain precautions and the proper apparatus used, no such conditions can be possible. I speak now from the actual employment of these rays daily to the chest wall for the aid in gaining early diagnostic signs of tubercular and other allied diseases if present.

This investigation gives me the right of an opinion, and I freely make it before you, showing how we all have fallen into that fallacious position by calling this phenomena as produced by these X-rays, burns, when they are nothing less, nor more than an inoculation. Now that we know how to remedy the dangers connected with their use and how best to avoid repetitions from recurring, and if they occur, whether the physician or who so applied them, is to take the blame if the proper precautions as in any surgical operation are not observed. All these facts I shall refer to in a few moments.

Let me eliminate from your minds that an X-ray application or the use of its photography is a dangerous procedure either on a long or short exposure. If this force is applied and handled by skilled hands and with suitable mechanism, there is absolutely no atom of fear in producing this phenomenon of inoculation known as X-ray burns.

This inoculation is due, according to my observation from a series of experiments to several physical effects produced by the generation of these rays and the general conditions present. It is a known fact that the use of the Ruhmkorff coil in connection with the generation of these rays, is an apparatus which gives an exceedingly high electromotive force and amperage, and therefore such high discharges when exhibited, produce certain physical conditions surrounding the atmosphere of the patient or person who is exposed to these X-rays. To sum up these physical facts, we find that this high discharge is leveled against the subject—carrying with it from the surrounding septic atmosphere certain particles floating therein, also surcharged with bacteria and foreign material upon the clothing and skin of the patient which are at all times present setting up sometimes infectious, and at other times an inflammatory condition from these forced driven septic materials under the skin exposed to this phenomenon.

This in flammatory or inoculated condition is the result of all these facts which I came upon during my crucial experiments and can be avoided without any difficulty now on the part of the operator by the adoption of a few rules gleaned from my practical experience which I shall give in the summing up of my remarks.

I now bring before your notice a few most important facts which are also highly corroborative directly within my own investigation. Those facts cannot help being appreciated at this moment, as they come also from several late observers who studied the question of burns, due to fire and hot water, etc., and the causes of death therefrom.

We already know that many deaths are due to burns produced from other causes than by the X-rays. This fact has puzzled scientists to account for deaths which occurred among persons suffering from other burns, even where the injuries received seemed wholly inadequate to produce fatal results. The havoc caused by skin diseases might be much greater and a far larger surface of the skin attacked, but generally a cure could be effected, whereas in the majority of cases of severe burns the end would be fatal.

That the X-ray burn always appears many days after the application of this force or light to a part of the body and does not show absolutely any early manifestation, as minutes or hours thereafter, but days elapse, even as late as eighteen days thereafter. These X-ray burns begin with a painful dermatitis slowly and symptoms resembling burns from heat or scalds. It is therefore that from the very outset and conditions the difference is apparent.

How should we avoid this dangerous condition in the application of the X-ray?

To sum up in a few clauses the whole matter, let me say the following, viz.:

Above all supplant the static machine for the Ruhmkorff coil. This form of electricity or energy has not the physical properties of carrying foreign material into the depths of the tissue so readily as the other current. Static electricity gives only the high voltage with low amperage, while the other is productive of both high forces, making it an unnecessary and dangerous appliance.

All parts to be either photographed or examined by means of these X-rays should have all clothing removed therefrom, and washed with an antiseptic solution or so prepared as if a surgical operation is to be performed. Also a room which is free from infectious material as possible, should always be made ready, or specially appointed for the purpose. Those are the cardinal rules and must not be deviated from in order to avoid a dangerous inoculation or poisoning.

Shoul. such an X-ray inoculation occur, from unforeseen causes or otherwise, sterilization of the affected part by means of electrolysis is the safest and quickest specific known to me—with the amputation of all loose tissue surrounding the parts. I found in my early work as far back as May, 1896, when I had been as unfortunate as others to inflict several patients with these inoculations (burns) that something more was present to deal with than an ordinary electro dermatitis. Experimental study of this question soon elicited facts that brought me to the discovery of the following remedial agent which I commend to your notice. Electrolysis or sterilization of the parts is a specific. The current decomposes all the infected material and changes them into some other non-poisonous compound thereby relieving the system of poisonous products. This is accomplished by placing such parts of the body into a salty solution of distilled water and connecting the electrode with the negative pole of a galvanic battery with a mil-ampere meter. The positive pole may be placed on any convenient part of the subject, vessels of porcelain, wood or glass are best. The strength of this current should average 5 mil-ampere to a square inch of surface to be sterilized—lasting at least one-half hour; after that time the polarity should be reversed for 5 to 10 minutes in order to set free the chlorine which will again react on all the external and internal exposed surface. Accurate measuring by means of a mil-ampere meter with the use of such current must be strictly adhered to—as serious conditions will arise unless one knows the exact amount of current passing and so as to judge the exact quantity of chemical action, thereby controlling its destructive effects, which if are not known will do serious injury to healthy surrounding tissue.

I know of no more satisfactory and scientific methods in the treatment of these X-rays wounds, and in fact in all deep and superficial wounds and poisonings, than sterilization by electrolysis as advocated in my method as here stated. All wounds with pus should first be drained by incision, before the above procedure is undertaken. I must also state in my recommending sterilization by electrolysis to those that hereafter apply it, they should at least be acquainted with the fundamental principles involving electro chemistry. Good judgment is necessary as

[1] Read before the Medico-Legal Society (Psychological Section), May 26, 1898.

much damage can be done if proper precautions are not observed. The time of application must be always left to the discretion of the operator, especially in deep seated conditions. Reapplications can be always resorted to. There are no contra indications for this treatment by electrical sterilization to any class of infected wounds and skin diseases presented to surgery. However, each case must be treated upon its own merits. After such treatment protective dressing of simple kind is necessary to keep the parts from further infections. To small wounds and infections a sponge electrode to suit the size, well saturated with salt solution, is a rapid way of applying electro-decomposition.

I bring my new and novel investigation before your notice for the first time in the history of antisepsis and hope that it will find its way into general surgery with as much and better satisfaction than the heretofore methods employed and give as good account of itself as it has in my hands.

This work has been the outcome of my early results obtained from the experiments and treatment of tuberculosis and other inflammatory diseases of the lungs, etc., which still occupies my time, already with most fruitful results.

My investigations brought me to a most important point, and that is that all microscopic crevices are cleaned of bacilli, their products, and pus cells, where in the use of antiseptic solutions, etc., a mere coating is effected therefrom and always liable to a reinfection. This form of sterilization does not absolutely admit of such a condition, as destruction takes place instantaneously by electro chemical decomposition also by reversing of the polarity of this current; these microscopical crevices are again closed completely by its electro dynamic action.

Electro sterilization must, therefore, be highly recommended as a prime antidote also to all kinds of stings, dog bites or in fact to even venomous wounds produced by serpents. The current should be applied a much longer time than for ordinary cases.

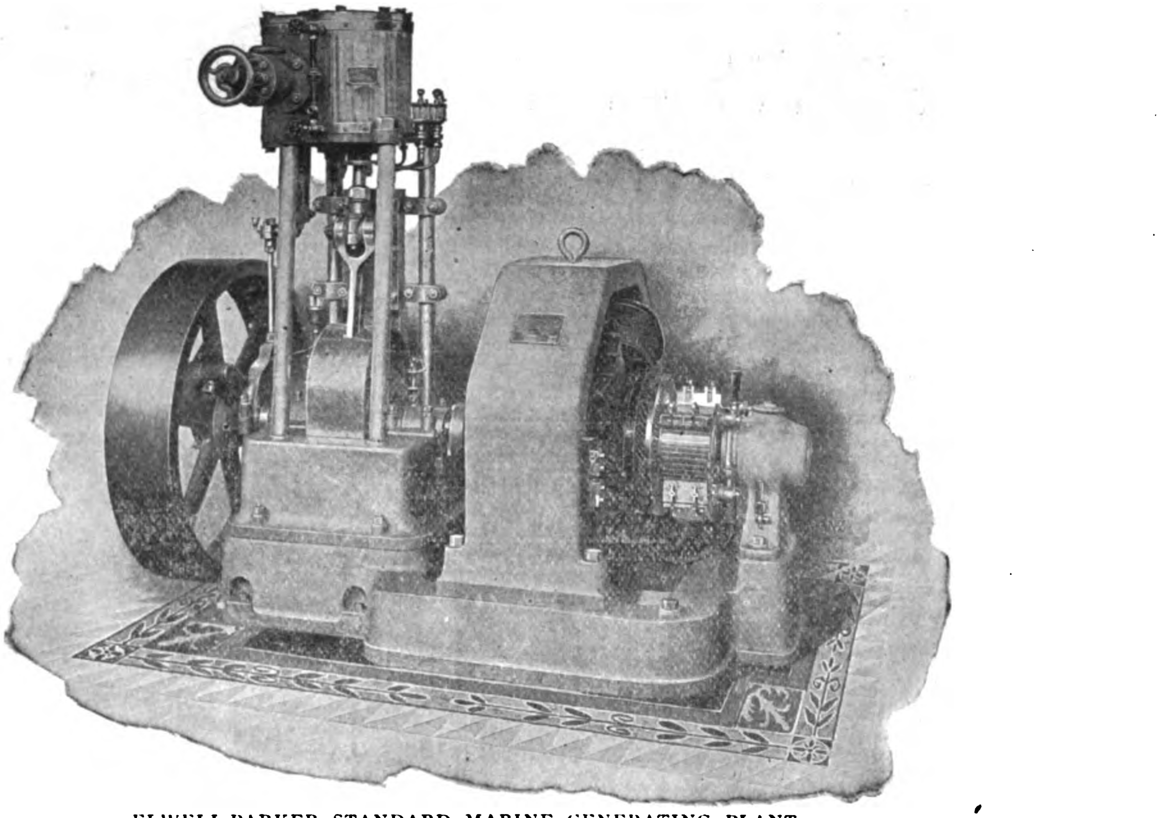
PULASKI, VA. The Pulaski Telegraph and Telephone Company has a capital stock of $24,000, 100 subscribers, a board with 140 drops and a number of toll lines. The apparatus has been built chiefly by the Telephone Manufacturing Company, of Sumter, S. C. Mr. B. Laughan is president and general manager, and D. D. Hull, secretary and treasurer. Rates are $15 a year, payable quarterl yin advance, and 10 cents is the toll rate.

NEWS AND NOTES

Elwell-Parker Standard Marine Generating Plant.

We illustrate and describe herewith the standard marine generating set recently brought out by the Elwell-Parker Electric Company of America, Cleveland, O. This apparatus has been developed by years of experience of the requirements in this class of machinery when used under the exacting conditions that prevail on shipboard. These sets are manufactured in sizes from 5 k. w. to 40 k. w., and, although designed, as we have noted, for special marine work, their compactness and satisfactory results have commended them strongly for stationary isolated installations in various classes of work on shore.

The dynamo is designed for a minimum weight, and to run sparklessly without any overheating. All connections are easily accessible and any parts that need adjustment or renewal are so disposed as to make the most convenient arrangement.



ELWELL-PARKER STANDARD MARINE GENERATING PLANT.

The engine is designed to be very open and all parts are made to be readily accessible. The bearings are extra large, and the oiling arrangements are such as to secure continuous oiling with the minimum of attention. The whole set is rigid and strong, so as to be proof against the jarring to which it is so much subjected on shipboard in rough weather.

The shaft has a coupling between the engine and generator so that each half of the set shall be, as it were, practically independent of the other half. The outboard bearing is self-aligning, self-oiling, removable and made to gauge so as to be interchangeable. A considerable number of these sets have been in use for some time on the lake steamers and have always given the most satisfactory results.

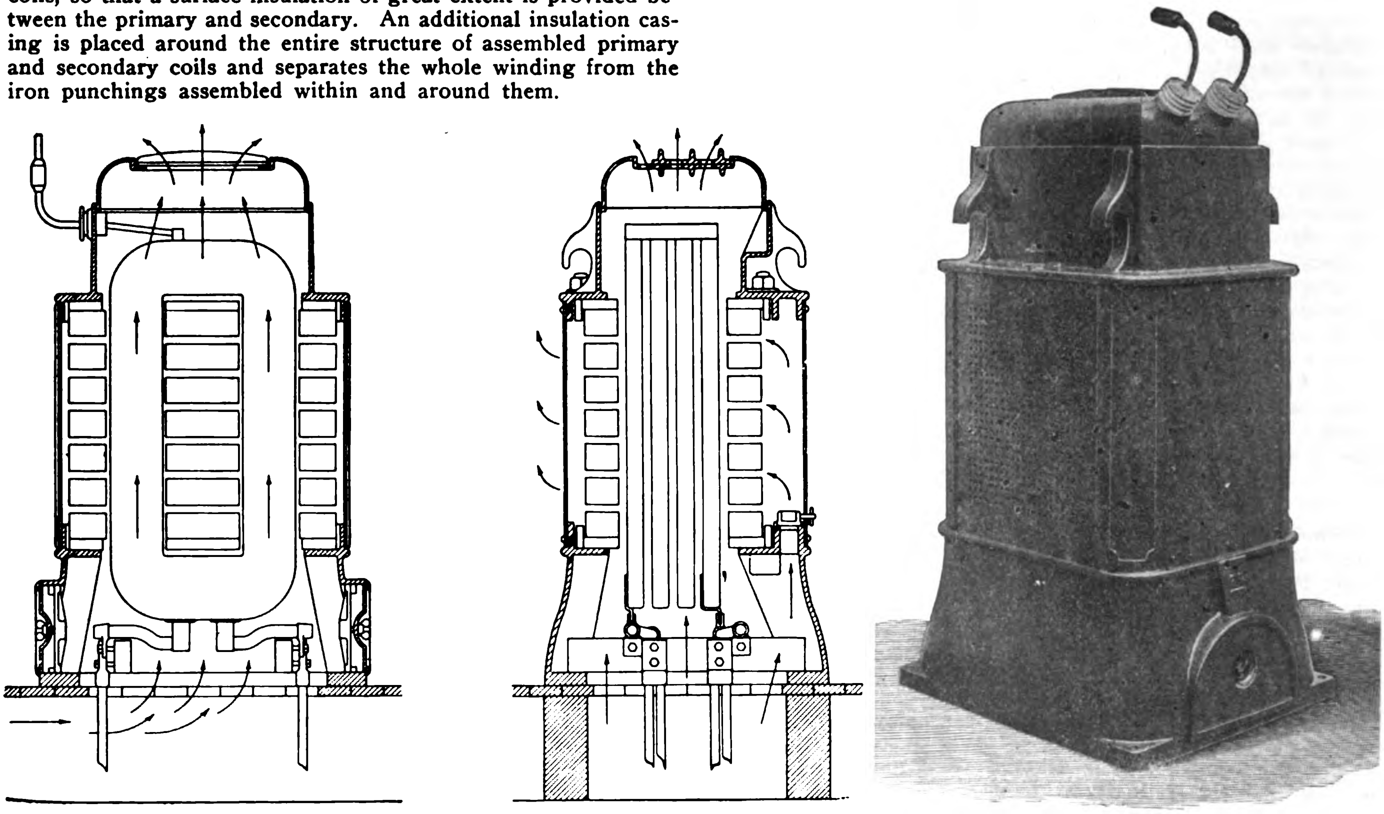
The accompanying cut shows the 10 and 20 k. w. sizes. The 10 k. w. size runs at 450 revolutions, the 15 k. w. at 400 revolutions and the 20 k. w. at 350 revolutions per minute.

Brooklyn, N. Y.—D. T. writes: "I should find it very hard to get along without the Engineer."

G. E. Air Blast and Natural Draft Transformers.

TWO methods are employed as standard practice by the General Electric Co. in the construction of its large transformers. In the "Air Blast" type the current of cool air is forced upward through the core and windings. In the "Natural Draft" type, the coils and iron are so proportioned and placed that large surfaces are exposed, and the temperature kept within safe limits by the natural circulation of the air.

The air blast type is designed for continuous operation, large output and high potential. In this type, the windings are subdivided into numerous independent coils each separately and heavily insulated. With such subdivision the voltage generated in a single section is low even in transformers wound for a voltage of 15,000 to 20,000 volts, and the numerous air ducts between all the coils which this subdivision allows, in addition to the spaces in the iron lamination of the core, limit the rise in temperature to a few degrees only above that of the active cooling air current. The coils are wound with flat copper conductors, cemented together by an insulating compound before the exterior insulation is applied. The method of winding and insulating produces a strong coil which will successfully resist any tendency of the conductors to vibrate. The use of rigid coils is important in large transformers since the magnetic force tending to move the conductor is great; and vibration abrading the insulation might consequently be set up. The primary and secondary coils are assembled in small intermixed groups with air spaces between the coils, and between every adjacent primary and secondary section are solid insulating diaphragms, which completely encase the primary winding except at either end of the core, necessarily left open to allow the air to circulate freely. At the end, however, the diaphragms project far beyond the coils, so that a surface insulation of great extent is provided between the primary and secondary. An additional insulation casing is placed around the entire structure of assembled primary and secondary coils and separates the whole winding from the iron punchings assembled within and around them.



G. E. AIR BLAST TRANSFORMER IN PERSPECTIVE AND SECTION.

The insulation in the primary coils will withstand an insulation test at the potential of operation. Another equally heavy insulation is on the secondary coil. The diaphragms between the primary and secondary coils will also withstand the primary potential. Entirely neglecting, therefore, the additional insulation due to the double air duct between the primary and secondary windings, the method of insulation employed assures a factor of safety of at least three. The insulation test between the high

G. E. NATURAL DRAFT TRANSFORMER.

potential windings and the core is made at a voltage equal to twice the rated potential. A similar test is also given the insulation between the primary and secondary windings.

The cooling current of air is obtained from a motor-driven blower and is forced from below through separate paths at right angles to each other, vertically through the windings and horizontally through the core. The admission of air is controlled by shutters at the top and at the sides of the transformer. The

power for the blower seldom exceeds one-quarter of one per cent. of the total capacity of the transformer, and in most cases is much less, frequently not more than one-tenth of one per cent. It is considerably less than that which would be required to pump oil through an oil-cooled transformer of the same capacity.

Air blast transformers are used on 15,000 volts potential or under and are constructed for higher potential when necessary. Owing to the attention given to the electrical design, the quality of the material used and careful workmanship, the efficiency under full load and partial load, determined under commercial operation conditions, is extremely high. The regulation on both inductive and non-inductive loads, similarly determined, is remarkably close—an important essential when incandescent lamps and motors are operated from the same transformer. Calculating the temperature of the interior of the air blast transformer by the rise in resistance of its windings, the rise in temperature is guaranteed not to exceed 40° C. above that of the surrounding air. Over 100,000 h. p. in these air blast transformers have been installed, and no record yet exists of a burn-out due to heating or overload.

In the "natural draft" transformers the dissipation of the heat is obtained by a natural circulation of the air around the coils. The essential parts of this transformer resemble those of the standard type H. transformer. The core is formed of two upright legs on which the coils are wound. These are joined together by two yokes which complete the magnetic circuit. The transformer proper is surrounded by a corrugated iron case and rests on a substantial base of cast-iron. The cool air enters from below and in passing through the transformer absorbs the heat and ascends, finding easy egress through the hood at the top.

Natural draft transformers of large capacity are much more expensive than similar sizes of the air blast type with air blast outfit, but for moderate capacities the costs per kilowatt of the two types are more nearly identical. The capacity required, together with the particular conditions of the installation, determine when the two types can be furnished at an equal cost, and in such cases the natural draft type is preferable on account of its greater simplicity. Natural draft transformers are built in sizes ranging from 5 k. w. to 200 k. w. They require no attention no blower outfit and may be located in any convenient place. The standard pressures for which these transformers are wound are 10,000 volts primary, and 3,120 volts or under, secondary.

Pelton Water Wheels at Auburn, Cal.

The Pelton Water Wheel Company have been awarded the contract for the hydraulic work of the new plant of the Central California Electric Power Company to be installed at Auburn, Cal. This station is to include two 43-in. wheels, to run under 200 feet head, at 300 revolutions, and develop 800 h. p. The wheels are to be direct connected to a 500 k. w. Westinghouse generator, which is to be electrically coupled to the generators running the Newcastle station of this company, six miles distant, and the power transmitted to Sacramento over the same pole line. The entire distance from the Auburn station is 34 miles.

The interesting features of this plant consist in running two stations so far apart in parallel; also in the double use of the water, it being the same as supplies the Newcastle station six miles lower down. With the rapid fall of many mountain streams, power can thus be multiplied indefinitely and generally within reasonable limit of transmission.

Niagara Power in Buffalo.

As soon as the necessary electrical apparatus and machinery can be obtained and installed the Urban Roller Mills, of Buffalo, will be operated by Niagara power. Steam power is now used. Had it not been for the delay of the makers of the electrical machinery, the mills would probably now be using the current from the Falls, but the demands of the Government had to be met first. However, it is thought the end of July will see the mills electrically operated. The main motor of the plant will be of 400 h. p. capacity, and it will be direct connected to the main shaft of the present system, it having been found possible to use the main part of the present system of shaft and pulleys in the mill. This motor will run all the machinery of the mill, with the exception of that of the grain elevator and merchandise department, and in these cases separate motors will be applied. In all, about 500 h. p. will be used, and a most efficient service is expected in all departments.

There is a good probability that Lockport will soon be in the enjoyment of electrical power transmitted from Niagara Falls, the transmission line, in all likelihood, following the line of the New Buffalo and Lockport railway from the Tonawandas. Lockport has about 16,000 inhabitants, and is quite a manufacturing point, but the power supply is anything but satisfying, as the water for power purposes is taken from the Erie canal, a State possession. It is thought Niagara power can be sold in Lockport for from $40 to $50 per horse power, which figure would probably induce several companies to use it, as the service would be constant for twenty-four hours in a day and 365 days a year.

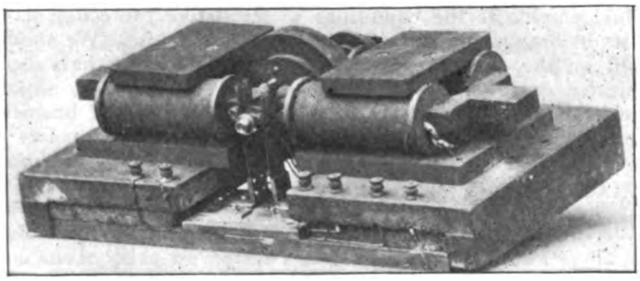
LETTERS TO THE EDITOR

Compound Winding.

My attention has been directed to the following passage which appears in your issue of May 19, 1898, under the heading of "Compound Winding—Patent Void:" "In deciding against the validity of the patent (Edison's) Judge Coxe, as it were, affirmed the decision rendered on the same patent in the English courts, where, after fierce litigation, the bill of the plaintiff was dismissed. In both these celebrated cases the Brush 'teaser' patent was held to be a plain anticipation."

Now, as a matter of fact, the compound winding litigation in England occurred over the respective claims of myself and Brush, to be considered the inventor of compound winding, and three legal decisions declared that Varley's patent, No. 4,905, 1876, was an anticipation of Brush's "teaser" patent, No. 2,003, 1878.

I would mention that almost immediately after the second judgment had been delivered in Edinburgh on appeal (July 16, 1890), and which not only confirmed, but strengthened the judgment which had been previously given, the Anglo-Brush corporation found it necessary to liquidate and to reconstitute themselves as a new company. At the final appeal to the House of Lords, their Lordships delivered judgment on April 5, 1892, and without hearing counsel on the other side they unanimously concurred in the two judgments which had been previously given, and they declared Varley to be the inventor of compound winding.



ORIGINAL COMPOUND WOUND MACHINE.
(Constructed by S. Alfred Varley in August, 1866.)

I enclose you a reprint of the judgment delivered in Edinburgh on July 16, 1890, when the case came before the court on appeal, and also a reprint of the judgment delivered in the House of Lords on April 5, 1892, at the final appeal; and I would call your attention more especially to the judgment delivered at Edinburgh on the occasion of the first appeal (June 16, 1890), certain passages of which I have marked.

I also enclose a reprint of a published letter returning thanks for the testimonial given me as a recognition of what I had accomplished in connection with applied science. I forward it simply because it contains a brief history of my intervention on behalf of the electrical industry in the matter of the compound

winding litigation, and which resulted in liberating the trade from having to pay royalties to the Anglo-Brush corporation.

Perhaps I may be allowed to mention that I had no pecuniary interests to serve when I intervened in the compound winding lawsuits on behalf of the industry as a whole, and that my professional services were rendered largely gratuitously.

Trusting to your courtesy and love of fair play to allow this communication to appear in your next issue, I am, sir, yours obediently, S. ALFRED VARLEY.

17 Lynton Road, Crouch End, London, N., June, 1898.

Abstracts of Discussion on Mr. Alexander Dow's Paper on "Public Lighting in Relation to Public Ownership and Operation."[1]

BY H. M. ATKINSON.

I TAKE that it is not the purpose here to discuss specific cases or grievances. Such an association as this should adopt a platform enunciating its principles on this question, which by its conservatism, temperate tone, fairness and broadness, will appeal to the taxpayer and intelligent voter. This platform should be carefully prepared, should avoid anything aggressive in its tone, or calculated to excite the opposition of advocates of the policy. We should state that we are opposed to municipal ownership on principle, not alone as owners of electric lighting companies, but as taxpayers ourselves. We should state that we are not engaged in a partisan fight, and that whenever one of our members is attacked, he is of necessity right, and must be protected, but that circumstances will solely govern the position we take in each case. We should state that after long experience and earnest study, we, as honest business men, believe that private corporate service under proper legislative control, is far better than municipal ownership. We must distinctly state that we will not uphold our members unless they are honestly endeavoring to give the best service at the very lowest living prices taking into consideration local conditions. We must show that private ownership under proper control means all the advantages of public ownership without any of the risks. We should emphasize the conditions of legislative protection as it exists in France and this country in Massachusetts. We should dwell on the depreciation and losses to which we have been subjected during the past ten years and still are. We should counteract the prevailing idea of great profit in the business. We should condemn at the start high prices and the policy of those who exact them, putting ourselves on record that as street-lighting contracts cover long hours and much consumption, that they should be treated accordingly.

We should adopt a standard system of accounts for ourselves and advocate the adoption of such a system by every municipality—one that will appeal to all business men, interested or not. We should endeavor to show that cities adopting this policy are providing the soil upon which rings and corruption exist, and without which they cannot. We should counsel fair and accurate expressions of facts and figures on both sides, emphasizing the injustice done by careless, inaccurate, unstudied statements. We should urge more complete and adequate methods of bookkeeping in all municipalities. We should drive home in the minds of the people that a city's only source of income is through taxation or bond issues, which means taxation perpetuated; that every dollar raised by the former method is costing them interest as much as the latter. We must urge that cities count cost as fully as private persons. Our fight, in short, is the fight for good and honest government. We must stand fairly on the platform that we, as taxpayers, as well as owners of electric light works, are opposed to the policy of municipal ownership and operation, as our experience has shown us what it is. We must show how legislative control, requirements and penalties create a degree of responsibility which never exists as regards a municipal corporation; how elimination of the factor of self-interest is an effective barrier to economy in production or operation on the part of a municipal corporation, and always will be; that private enterprise will always outstrip municipal ownership in filling the gap between supply and demand; that under contract cost is limited to the price, and under municipal cost is not limited. We should point out the difficulty of ever getting true statements of cost if this policy is inaugurated, as advocates of it will not willingly issue statements condemnatory of themselves, and politicians will not take action that will decrease their patronage. It should be pointed out to taxpayers and voters that municipal ownership of electric light plants will only be a stepping-stone to ownership of numerous other industries, for if ownership of one is advisable why not all?

We should educate public opinion to the unfairness of municipal competition with capital, invited and encouraged to occupy the field, when an industry is an experiment, as long as such capital furnishes good service at a fair price, and that such competition is equivalent to condemnation and confiscation of property without compensation.

BY SAMUEL SCOVIL.

Each of us, I think, will agree with the statement that Mr. Dow makes in closing his able paper—that there is immediate need for clear thinking and for well-considered speech and action in reference to the attitude being assumed by the public towards those corporations performing so-called public services.

In regard to public lighting only, Mr. Dow advocates a declaration of principles by the Association and a recommendation by it to its members of a policy based on those principles. If his suggestion be acted upon, the Association must be careful that the principles which it enunciates and the recommendations accompanying them shall be such that wherever they may be fully accepted and adopted they will result in reasonable prices being offered to the municipality and a fair return to the company upon its invested capital.

I use the words "invested capital" advisedly, for I take decided exception to the principle laid down by Mr. Dow that the present value only of a lighting plant is the proper basis upon which to adjust a price for public lighting. The growth of the electric lighting industry has been almost unexampled in rapidity, and as a natural sequence much of the apparatus originally installed in the average lighting plant has been replaced not once but several times because it had been obsolete. This was no ordinary depreciation such as might properly have been anticipated. It was extraordinary in its character and in degree. For reasons well understood by you, it was impossible for the managers of these plants to secure a price for the service rendered by them which would allow them to cover this depreciation, even could they have anticipated it. As a case in point, I will state that I am informed that there is not in use to-day in the lighting plant owned by the city of Chicago one single piece of the electrical apparatus placed in when the plant commenced operation. It was the necessity of buying new equipment and charging its cost to operating expenses that made the cost of operating street arc lamps by the municipal plant of Chicago for labor and material only $96.40 per lamp per year. You will find these figures given as the cost on page 35 of the Mayor's message for 1896.

Aside from this fact, the original investors in electric lighting apparatus had to pay for patent rights, and these constituted a no inconsiderable part of the aggregate amount of capital which they had to put into the business.

Suppose, for example, the municipality had issued bonds for the total expenditure on its plant, and these bonds, as would probably be the case, were all now outstanding, no one would deny that the interest on such bonds would necessarily be a part of the cost of its public lighting service.

This is in a measure the position which many of the private lighting plants are in to-day. Moreover, it is a fact that it has been the very readiness of the private lighting companies to replace and enlarge their original installations, and of the street car companies to do likewise, that has made possible the great development both as to efficiency and cost of the electrical appliances of to-day. If the municipalities had undertaken the business entirely at the outset, it is not at all unlikely that the development and consequent extraordinary depreciation would not have been anything like as rapid.

As I understand it, the proposition made by Mr. Dow, if accepted by this Association, might well be stated in a resolution, as follows:

"Resolved, That we, the managers of private lighting com-

[1]Printed in the Elec. Engr. June 23, 1898.

panies, in convention assembled, deliberately declare that it is perfectly equitable that part of the capital which we have invested in good faith and with commendable enterprise, be now confiscated by the municipality which we have been serving."

There is one other principle which Mr. Dow asks us to accept, to which I think exception should also be taken. He says: "The only sufficient reason why a municipality should contract with a private company for public lighting is that the private company can do the work, and is willing to do it, cheaper than the municipality can itself do it by direct operation of a public lighting plant."

In my opinion, preference should in every case be given to the private company at the same cost. A contract made with a private company is a known expense. Municipal ownership and operation is an unknown expense. Aside from this fact, however, there is a larger and an all-sufficient reason why private enterprise should be given the preference and individual effort be thereby stimulated.

The question as to whether the municipalities of this country shall own and operate their own lighting plants may seem to be a small matter, except to those whose money is invested in such plants. The axiom that it is the first steps which count is as true of a community as it is of an individual. Once fairly started upon the policy of the municipalization of all public utilities, and who can tell where governmental interference with individual effort will stop. Will it stop with the municipalities? No! All history and experience show that wherever a people have entrusted their liberties to their representatives, to be exercised through a centralized power, these liberties have been lost to them.

The following would seem to be much more acceptable than Mr. Dow's proposition, and be more in accord with American institutions, which is to interfere as little as possible with the individual activities of the citizen:

"The best interests of the public welfare require that a municipality should contract with a private company for its public lighting if the private company can do the work and is willing to do it at a cost not greater than if supplied by a plant owned and operated by the municipality itself."

TELEPHONY AND TELEGRAPHY

The Atlantic Cable Directory and Code.

A FEW months ago The Electrical Engineer published an account in detail of the new book, as above, which has now been issued by the Atlantic Cable Directory and Code Company, of 253 Broadway, New York City. The volume is a massive and handsome one, in a large octavo of nearly 700 pages, bound in brown canvas, stamped in black lettering, and it constitutes an invaluable addition to the mechanism by which international communication is facilitated and international commerce expedited.

"The Atlantic Cable Directory of Registered Addresses and Directory Code" contains a directory of registered cable addresses of the United States and Canada, the names of individuals and firms being arranged alphabetically by States, cities and names, and also classified under the proper business headings. It also contains a telegraph and cable code of about 115,000 code words. The officers of the Atlantic Cable Directory and Code Company, which company is publishing the book, are officials and employees of the Commercial Cable and Postal Telegraph Companies, and this fact in itself is a guaranty of the character of the book. The Commercial Cable Company has guaranteed that 100,000 copies will be printed and circulated, the bulk of them going abroad to be placed in hotels, exchanges, steamship offices, clubs and other public places, as well as in the hands of leading business houses.

The code is so arranged that almost any sum of money in American, English, French, German, Italian, Russian or Spanish currency may be expressed in one word, and one word may also be found to express any quantity, weight or measure in the English or metric system. Phrases descriptive of securities and names of important corporations and active stocks may each be expressed in one word, and phrases for use in shipping are particularly full and complete. Thousands of code words with blanks opposite are scattered through the book, so that the code is especially adapted as a foundation for the preparation of special codes between correspondents.

In the plan and arrangement of the code a radical departure has been made from methods followed by makers of other printed codes heretofore published. Instead of following the old plan of grouping the phrases under subject headings the compiler has first condensed plain English sentences by eliminating the articles and less important parts of the verbs and has then broken them into combinations of words ordinarily in use. The phrases thus formed have been arranged in alphabetical order and may readily be combined into complete sentences. In short, the "Directory Code" is a dictionary of word combinations, although the more useful common sentences and phrases have been included. By the use of the "Directory Code" any ordinary English sentence may be condensed, at least to some extent, and the sentences used in every-day business correspondence may be condensed to a surprising degree.

MARRIED

Johnson—Estell.

Mr. John H. Johnson, of Binghamton, N. Y., was married on June 20 to Miss Florence Estell, daughter of Mr. and Mrs. George Estell, of Kansas City, at the home of the bride's parents, Rev. Dr. H. C. Stanton officiating. The happy pair will reside in Binghamton, N. Y. Mr. Johnson is a well-known engineer in the northern part of this State, having been for several years connected with the F. P. Little Electric Supply and Construction Company. He is now connected with the New York State Electrical Engineering Department.

Osborne—Gale.

We are glad to announce the wedding on June 20 of Mr. W. P. Osborne, of the "National Provisioner," to Miss Emma Catharine, daughter of Mr. W. McClure Gale, of Brooklyn. Mr. Osborne was for a long time the Eastern representative of the "Western Electrician," and his work did much to popularize himself and that journal in this section of the country. A host of friends and admirers extend their congratulations and hearty good wishes.

SOCIETY & CLUB NOTES

An Enjoyable Outing.

The Department of Public Buildings, Lighting and Supplies had their annual outing on Saturday afternoon, June 25. Four tally-ho coaches conveyed the party numbering about 150 from 125th street and Third avenue to Hefter's Hotel, Pelham Bay Park, where an elaborate clam bake was served and enjoyed by all present. During the afternoon, football, baseball, rowing and other games were indulged in until the fierce storm put an end to all outdoor sports. The resources of the company were not however by any means exhausted, as quite a number developed marked musical talent and afforded a fund of amusement for hours. The storm fortunately did not last long, and about 9 o'clock the whole party enjoyed a cool and refreshing drive home, which was particularly delightful after the oppressing heat of the day.

MESSRS. LIEB, VAN VLECK AND WILLIAMS, of the New York Edison Company, have sailed for their European trip of investigation, of which note was made recently in these columns.

INVENTORS RECORD

Classified Digest of U. S. Electrical Patents Issued June 21, 1898.

Alarms and Signals:—

ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS. L. C. Werner, Broad Brook, Conn., 605,941. Filed July 22, 1897. An automatic electric signal system by means of which when a train is about to leave a block, a signal will be transmitted to the engineer in the cab if the block in advance of him is not clear.

ELECTRIC ALARM SYSTEM. A. Overden, Akron, Ohio, 606,076. Filed Sept. 24. 1897. Consists of an electrical circuit closer, an inclined way comprising a conductor rail having a laterally extending plate, a non-conducting rail secured to the plate, and having conducting portions.

Dynamos and Motors:

ELECTRIC MOTOR. F. E. Briner, St. Louis, Mo., 605,850. Filed Aug. 21, 1897. Embodies an armature comprising an elongated core, and induced current-conducting bars whose ends are bent one upon the other, the ends interlocking with each other.

MEANS FOR COMPENSATING FOR TEMPERATURE RESISTANCE CHANGES. C. F. Scott, Pittsburg, Pa., 606,033. Filed Jan. 21, 1895. Combines a movable armature with shunt and series connected circuits in inductive relation thereto, and non-inductive resistances of different values in the respective shunt-circuits and one of which has a different temperature-resistance coefficient from the other.

ALTERNATING CURRENT ELECTRIC MOTOR. R. H. Hassler, Pittsburg, Pa., 606,056. Filed Sept. 6, 1895. A method of regulating the speed of rotation of a shaft in alternating current induction motors.

Electro-Metallurgy:—

ELECTROLYTIC PRODUCTION OF AMALGUMS, ETC., E. and G. Andreoli, London, England, 605,835. Filed Sept. 17, 1896. Consists of a cell provided with positive and negative compartments separated by porous diaphragms, the negative compartments having a raised middle portion in the form of a table, vertical spaces between the table and partitions, and mercury covering the table and filling the spaces to form a continuous cathode.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. F. Wright, Newburg, N. Y., 606,108. Filed Oct. 7, 1897. Comprises a casing, carbon magazines mounted on the casing, carbon holder tubes extended from the magazines and converging, carbon-locking plates on the tubes, and means for automatically operating the plates.

ELECTRODE FOR ARC LIGHTS. C. S. Dolley, Philadelphia, Pa., 606,127. Filed Nov. 21, 1896. An electric arc electrode manufactured of calcium carbide.

Measurement:-

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 605,862. Filed May 20, 1897. Embodies a cylindrical armature, a shunt field within the armature, and a series field without the armature comprising separate horseshoe-shaped cores partially embracing the armature, and series coils wound upon the cores.

ELECTRIC METER. T. Duncan, Fort Wayne, Ind., 605,949. Filed June 24, 1897. Provides a cylindrical armature, a series field without the armature, and a shunt field within the armature comprising a cross-shaped core, and shunt coils upon the several poles of the cross-shaped core.

SHUNT FOR ELECTRIC CIRCUITS. O. B. Shallenberger, deceased, M. W. Shallenberger, executrix, Rochester, Pa., 606,171. Filed April 22, 1897. A shunt for measuring instruments designed to maintain a practically fixed proportion between the currents in the branches, notwithstanding considerable variations in the temperature of the surrounding air.

Miscellaneous:—

ELECTRICALLY HEATED CHARGE FOR CARTRIDGES OR SHELLS. L. W. Bates, Chicago, Ill., 605,842. Filed June 30, 1898. Consists in a cartridge containing an agent adapted to be converted into gas or vapor by heat, together with means for producing the necessary heat electrically.

Railways and Appliances:—

ELECTROMAGNET SWITCH RAILWAY. A. Norman, Toronto, Canada, 605,970. Filed July 3, 1897. Sectional conduit system.

ELECTRIC CONTROLLER. M. W. Hanks, Madison, Wis., 606,009. Filed Dec. 17, 1897. Comprises a contact cylinder mounted on a rotatable shaft, a second shaft having actuating means and a disc provided with springs, the springs engaging with a pin extending from an arm on the cylinder shaft.

ELECTRIC BRAKE. E. W. C. Hoffman, Charlottenburg, Germany, 606,167. Filed Dec. 29, 1897. Comprises a dynamo suitably mounted to be driven by the movement of the controlled wheels and an electromagnetic brake appliance connected with the dynamo, a controlling circuit, and an electromagnetic controlling device connected in the circuit adapted to secure the transmission of the current from the dynamo to the brake appliance when the device is actuated.

Regulation:—

CONTROLLING MECHANISM FOR ELECTRIC MOTORS. G. Gibbs, W. S. Johnson and H. Winkenwerder, Milwaukee, Wis., 605,953. Filed May 10, 1897. Details of construction.

ELECTRIC CURRENT CONTROLLER. J. J. Hogan, New Haven, Conn., 606,012. Filed July 15, 1897. Device for reducing and controlling the intensity of an electric current with a view to enabling a current of normally high voltage to be applied to uses in which a low-voltage current is required.

SYSTEM OF ELECTRICAL DISTRIBUTION AND REGULATION. B. G. Lamme, Pittsburg, Pa., 606,015. Filed Feb. 10, 1898. A method of controlling the speed of a rotary transformer whereby it may be maintained substantially constant irrespective of changes in the amount of inductive load on the alternating current circuit.

Switches, Cut-Outs, Etc.:—

ELECTRIC CLOCK-CONTROLLED SWITCH MECHANISM. R. W. Rollins, Hartford, Conn., 605,915. Filed Sept. 27, 1897. Comprises a clock-controlled switch mechanism, combined with an electric circuit, a clock controlling the circuit and embodying three co-operative circuit controllers, two of which are separately adjustable relatively to each other and are connected with one side of the circuit and control, respectively.

THERMAL CIRCUIT CLOSER. L. Emdin and J. A. Dewson, Reading, Pa., 606,004. Filed Nov. 19, 1897. Particularly adapted for use on an auxiliary fire alarm system.

Telephones:—

TELEPHONE TRANSMITTER. F. A. Ray, Boston, Mass., 605,913. Filed Aug. 18, 1897. Of the granular carbon type.

TELEPHONE EXCHANGE SYSTEM. W. W. Dean, St. Louis, Mo., 606,162. Filed Feb. 6, 1897. Party line system.

LEGAL NOTES

The War Revenue Law.

The following items from the new War Revenue Law relate to the telegraph and telephone and are expected to ensure not less than $750,000 for the Government, the telegraph tax being 1 cent per message:

Sec. 18. That on and after the 1st day of July, 1898, no telegraph company or its agent or employee shall transmit to any person any dispatch or message without an adhesive stamp, denoting the tax imposed by this act, being affixed to a copy thereof or having the same stamped thereupon, and in default thereof shall incur a penalty of $10, provided that only one stamp shall be required in each dispatch or message, whether sent through one or more companies; provided that the messages or dispatches of the officers and employees of any telegraph or telephone company concerning the affairs and service of the company and like messages or dispatches of the officials and employees of railroad companies sent over the wires on their respective railroads shall be exempt from this requirement; provided further that messages of officers and employees of the Government on official business shall be exempt from the taxes herein imposed upon telegraphic and telephonic messages.

Telephone Messages.—It shall be the duty of every person, firm or corporation owning or operating any telephone line or lines to make within the first 15 days of each month a sworn statement to the collector of internal revenue in each of their respective districts, stating the number of messages or conversations transmitted over their respective lines during the preceding month for which a charge of 15 cents or more was imposed, and for each of such messages or conversations the said person, firm or corporation shall pay a tax of 1 cent, provided that only one payment of said tax shall be required, notwithstanding the lines of one or more persons, firms or corporations shall be used for the transmission of each of said messages or conversations.

THE STOCK MARKET

Conditions Generally Good.

Perhaps the best indication of the improvement in trade is to be found in the statement of the New York State Factory Inspector, that 40,000 more people were employed this year than last, in factories under his supervision. Bank clearings are large again, also railroad earnings, while the outlook for fall trade is reported excellent. The large number of small subscriptions to the new 3 per cent. war loan is taken to show confidence in the government and widespread approval of its policy.

Operations in the stock market have been rather restricted and narrow, and the tax on sales of stock is debated as a possible check to speculation. During the past week, 64,960 shares of Western Union were sold, rising from 90 to 93¾. Only 3,717 shares of General Electric were sold, up to 38¼. In Boston Bell Telephone was up to 274.

Copper is quoted at 11.75 cents, being a trifle lower. Heavy steel rail, Eastern mill, is quoted at $17.50.

TRADE NOTES & NOVELTIES

Manufacturers and Dealers in Electrical Supplies in Pittsburgh.—Notes from the Field.—IV.

AURORA ARC LAMP MANUFACTURING COMPANY.

An enclosed direct current arc lamp differing in several particulars from those already on the market is being built by this company. It sustains all the claims made for enclosed arc lamps in general, for instance, a steady soft light, free from shadows, sparkless, long life of carbon (150 to 160 hours as against 8 to 12 hours in the open type of lamp), cleanliness, a minimum expense for cleaning and trimming, and high efficiency (it being 15 times greater than incandescent lights per unit.) Besides these claims, it has several new features, while it leads all others in simplicity of construction.

Two styles of lamps are manufactured, one known as the of-

Office Lamp. Factory Lamp, Exposing the Mechanism.
AURORA ARC LAMPS.

fice, the other as the factory type. The former is only 20 inches in height, while the latter is made any length from 25 to 30 inches. The special features include the mechanism employed for adjusting the carbons, which is very simple, not a wheel or spring being employed. The carbon holder consists of a hollow plunger, which forms the armature of a single coil solenoid. This carries near the lower end a split ring or clutch, which supports a pair of joggle joints terminating in a cam clutch which embraces the carbon just below the plunger, and these are reinforced by a contact plate on each side, insuring proper contact with the carbon, whether the clutch is opened or closed. As the arc increases the force of the solenoid is weakened, when the plunger falls till the clutches rest on a plate, which causes them to open, when the carbon slides down into place and is again lifted to a proper adjustment. The carbon is prevented from falling out of the plunger by means of a split thimble, into which the carbon is pressed when it is first inserted. The opening of the tube is too small for the passage of the thimble, but in the tube it slides freely. At its upper extremity the plunger enters a stationary thimble, which acts as a dash-pot, and cushions the motion of the carbon in either direction. The resistance coil is placed in the canopy upon a porcelain cup, having spiral grooves, into which the resistance coil is laid. The switch is also located on the canopy, but may be placed in a wall socket if preferred. A catch is also provided which is designed to hold the upper carbon at its highest point while the trimmer is adjusting the lower carbon. This is a feature peculiar to this lamp. The lower carbon is held in a split brass socket, which is supported by a single side arms from the frame. This socket also holds the inner globe in position, it being provided with an asbestos washer on its lower extremity, which embraces the lower part of the globe, and is clamped in position by a nut on the under side. This socket is also hollow, and is covered with a cap at the lower end, which provides for removing a carbon should it be broken off in the socket. The outer globe is supported by a split ring and two chains which hook over the canopy.

In the factory type of lamp the solenoid is placed to one side of the centre and there is a split horizonal lever provided which is attached to the armature at one end and at the other to a dash-pot; the same lever actuates an arm, having a ring which embraces the plunger (or carbon receptacle). The motion of the ring adjusts the carbon in about the same manner as described for the clutches. The cases are made of Russian iron and are dust-proof. The lamps are furnished to burn singly on 110 and 220-volt circuits, and in series of two on 220-volt circuits. They are also made for 500-volt circuits. When adjusted for 110-volt circuits they consume about 5 amperes of current. The arc consumes from 75 to 80 volts. The insulation employed in the lamps is all of mica and lava. It is interesting to note that light from an enclosed arc lamp is the only electric ray by which colors can be matched.

It is the purpose of the company to bring out very soon an alternating current and a constant current lamp after the same design.

They also make a focusing lamp which embodies the above principles and is used for stereopticon effects and street advertising.

The company have recently moved to the fourth floor of the Standard Building, No. 2, in Virvin Alley, Pittsburgh, and have fitted up their shop with a fine equipment of tools and appliances with a force sufficient to turn out 100 lamps per week. It is proposed to increase the capacity in the near future to 300 lamps per week.

Mr. L. W. Washington is general sales agent and manager.

Shiffler Bridge Company, Pittsburgh.

The name "Bridge Company" suggests only one branch of the business in which this company are engaged. While they build many bridges, by far the largest portion of the output from their extensive works is steel structural work, including plate and truss girders for roof supports in large buildings, such as electric lighting and street railway power stations, car houses and machine shops. This branch of their work takes them into the field of allied electrical industries, and a description of the process of manufacture and of the plant equipment will enable a prospective purchaser to judge whether he is putting his order into the hands of a concern that is able to execute a contract properly and promptly. A run through the works would satisfy the most exacting engineer that these two requirements could be amply met. We find two great buildings of corrugated iron, one 200 feet square and the other 150x60, adjoining the first and opening into it. These are flanked on two sides by extensive yards, in the first of which we find great piles of new material, consisting of plate steel in sheets of various sizes and thickness, I-beams, angle bars and channel bars of almost every size and description. Five large jib cranes, which are nearly all operated by pneumatic power, together with air trolley hoist, serve to unload the material from the cars, pile it, or deliver it to the trucks and trolley hoist within the

building. Here numerous other pneumatic lifts and large traveling cranes pass it to the shears or punches and drills, of which there are several of enormous proportions. It goes on from these to the riveting departments, where portable or trolley pneumatic riveters quickly pin the parts together, till they grow into knees, triangles or long truss girders, whatever the designs may be. The cranes operate with little or no outlay of power on the part of the operators, the large cranes adjusting the positions to suit the riveters and finally depositing the completed work in the storage yard, where it is painted and ready to be placed on board cars by similar appliances, the cars coming directly into the yard and into one side of the erecting shop. The machine shop proper occupies quite a space in the main building and has a large equipment of metal working tools for making the special tools and appliances employed in the work. In the blacksmith department are five forges and several furnaces, in which are heated the rods from which the rivets are made. There is also a large steam hammer and a number of rivet-making machines, which cut perfectly headed rivets from red-hot bars about as fast as one can count A Straight Line engine provides the power for operating the machinery and the air compressors, of which there are two of the Rand type. There is also a small compound engine of the Westinghouse, Jr., type, for running the lighting generator. About 250 men are ordinarily employed. Among the buildings now under contract by this firm is one covering nine acres, which is to be the tinplate plant of the Shenango Valley Steel Company, at New Castle. Pa. This structure will properly consist of three buildings, each 110x1,206 feet. Among the large structures built by this firm for street railway purposes is that of the Woodland avenue car house for the Union Traction Company, of Philadelphia.

The business was organized in 1883 by the present president of the company, J. W. Walker, and was reorganized in 1890 under the present name. The works are located at Forty-eighth street and Allegheny Valley Railway. The office and designing department occupy a separate building at one corner of the shipping yard.

Keystone Telephone Company, of Pittsburgh.

THIS is not only a telephone manufacturing company, but the managers are also engaged in organizing local companies, and are contractors for the building and equipment of local exchanges. This branch of the work is assuming mammoth proportions, and the number of exchanges under contract at the present writing is twenty-four, with a total equipment of 4,350 telephones and switchboards.

The type of instrument manufactured is known as the Keystone, and these are built in twenty-five different styles, including instruments for short and long distance work; telephones for inter-communicating systems and linemen's test sets. They also manufacture switchboards of all sizes, and special claims made for these are simplicity of construction, durability and rapidity of operation. The wiring is of the best grade of rubber-covered wire, while extremely long and positive spring connections of German silver for the operators' keys and for the jacks, are employed. The boards are of ample proportion, those for 100 drops being 17x20 inches. The drop magnets are of peculiar construction and very sensitive. Each is enclosed in a metal tube, and when in position they are about 3 inches long and 1 inch in diameter, with the armature at the back end. This is attached to the short arm of a delicate lever or catch, which extends along the upper side of the case and by a hook holds the drop cap in place. The slightest motion of the armature releases the catch and lets the drop fall. The transmitters are of various forms, depending upon the results required. For short line work, up to 30 miles, the carbon ball type of transmitter is used. With this transmitter one cell of battery only is required. For long-distance work where considerable battery power is required, a revolving transmitter of the Hunning type is employed. This is so arranged that by turning the mouthpiece at intervals the carbon granules are stirred up, and the trouble from packing is avoided. The long-distance arm transmitter telephone No. 11 is the most popular Keystone instrument, and is of the solid back type, similar in construction to that of the American Bell long-distance, fitted with standard generator and receiver, long-distance transmitter, gravity switch and two cells of batteries. These instruments are claimed to be equal, if not superior, to any long-distance telephone in use, being able, as shown by numerous tests, to do the same work that is being done on any long-distance line, working satisfactorily between New York and Chicago. The standard receivers used in these instruments are made of the best compound bar magnets, with hard rubber cases. The magneto bells are constructed with three magnets, which are placed side by side. These are each made from 1x¼ inch bar steel, cut into 16-inch lengths and bent into a horseshoe form. All are nickel-plated, as are also the connecting bars. First-class material is always employed, and the magnets have never been known to deteriorate from use. The induction coils are of different sizes, depending upon the kind of work, and are of unusual length, thus keeping the wire near the core, so that they have unusual power.

This firm make a specialty of an inter-communicating system for use in business houses and manufacturing establishments, so that all the departments may communicate with each other, independent of any exchange, as a switch is provided in each instrument, by means of which any two may be connected. The instruments in this case are sold outright to the purchaser, and over 2,000 have been installed in Pittsburgh.

The company also manufacture and sell an automatic lightning arrester, designed especially for telephone exchanges, and for this they find a large demand. These are placed between the line and switchboard connections. This consists of an arrangement of springs connected with the armature of an electro-magnet, and so placed that should a heavy current, either from lightning or an electric light wire, come into a line it finds an outlet through the ground strip from the line spring, through a thin piece of perforated mica, and in its passage it energizes the magnet, when by the action of the armature a spring is released, throwing open the circuit and grounding all the lines. The switchboard operator can then in a minute cut off the line having the excess of current, when by replacing the spring the system is again in service. This is claimed to be an absolute protection against burn-outs.

The company also make a specialty of building party lines. There is one running out of Pittsburgh 125 miles in length, on which are 24 instruments, all giving good satisfaction.

The shops of the company, with the office in the same building, are located on Old avenue, not far from the courthouse, and occupy a four-story structure 30x120 feet. About 100 men are employed, and the sales are about 75 instruments a day.

The company is backed by local capitalists, and is under the direct management of Mr. J. G. Ihmsen and Bert Hubbell, secretary and treasurer. Mr. Hubbell claims to have inaugurated the first opposition telephone system in this country, having established an independent exchange at McKeesport, near Pittsburgh, at which time the pioneer company had 60 subscribers, for which the charge was $84 per year. The city now has 900 telephones, which are furnished at a cost of from $12 to $30 per year.

American Wheelock Engines.

The American Wheelock Engine Company, of Worcester, Mass., report the following engines ordered, installed or in course of construction: Six 1,500 h. p. engines for the Chicago City Railway Company, with rope drives; 1 600 h. p. single cylinder condensing engine for the Worcester Wire Mill; 1 200 h. p. for Hammond-Reed Company, Worcester; 1 1,000 h. p. for B. B. & R. Knight, Providence; 1 550 h. p. single cylinder and one 550 h. p. cross compound with rope drives, complete, for Syracuse Construction Company; 1 400 h. p. for the Willamette Pulp and Paper Company, Oregon City; 1 300 h. p. and 1 350 h. p. for Pejepscot Paper Company, Brunswick, Me.; 1 750 h. p. direct connected for the New York Heat, Light and Power Company; 3 350 h. p. direct connected for the J. G. White & Co., New York; 2 500 h. p. cross compounds, direct connected, for Potomac Electric Power Company, this being the second order from them, the previous order being 2 750 h. p. direct connected. They have installed at the Grosvenor-Dale, Conn., electric light plant the high pressure side of a cross compound, putting their cylinder and valve gear on Corliss engine bed, replacing Corliss cylinders. This is the second Corliss engine in the plant they have replaced with cylinder and valve gear. They are now building for the Bibb Manufacturing Company, of Macon, Ga., the high pressure side of a 750 h. p. cross compound, the low pressure side to be one of their low pressure cylinders with valve gear, which replaces the Corliss cylinder and valve gear now on.

Recent Telephone Installations of the Sterling Electric Co.

The Eastern Illinois Telephone Company have just completed the installation of the Sterling Electric Company's new standard switchboard at their exchanges in Gilman and Sheldon, Ill. There is already to be seen a marked improvement in the service.

The E. H. Martin Telephone Company, of Webster City, Ia., are rebuilding their entire plant. The overhead wires are carried in 100-wire cables, the cable terminals, the protective devices and the switchboard being of the Bell type, manufactured by the Sterling Electric Company, of Chicago.

The Livingston County Telephone Company, of Pontiac, Ill., have completed their new exchange building. The poles are erected, the wiring now being put up for the removal of their central office. This new office will be complete in every respect, being equipped throughout with the standard apparatus of the Sterling Company.

Secretary Kimmel, of the Southern Illinois Telephone Company, of Mt. Vernon, Ill., states that his troubles are at an end. He now occupies an easy chair in the rear of the room and enjoys life, having just installed complete Sterling apparatus.

Dr. F. A. Winne, of Brockport, N. Y., has one of the most successful and best equipped telephone exchanges in the independent field of Western New York. His theory has been that the best is none too good. The outside construction is fine, the central office equipment is that of the Sterling Company. The exchange opened by June 5 under the most favorable auspices.

The Valley Telephone Company, who are operating in Saginaw, West Saginaw, Bay City, West Bay City and Flint, will probably have all of their exchanges in operation before the first of July. It is said that the engineering work upon these different exchanges of this company is the best that has been displayed in the construction of independent exchanges. The conduit work, the cable work, the pole-line work, the inside wiring and the arrangement of the exchanges themselves being models of workmanship and of perfect arrangement. This company is equipped with the full line of the Sterling Electric Company, including the switchboards, distributing boards, cable terminals, pole-top terminals and protective devices. The exchanges are well worth a visit by prospective builders or telephone users.

CATALOGUES.

Stanley & Patterson.

The eleventh edition of the above firm's catalogue has just been issued, and contains much valuable information about their well-known telephone apparatus, such as long-distance, combination, interior, short-line and desk telephones, long-distance and grain carbon transmitters, telephone switchboards, transformer coils, receivers and magnetos. They also illustrate and give prices of the well-known Ericsson Swedish telephones, as well as batteries, line wires and material. It is a well illustrated and complete catalogue, and can be had on application to Stanley & Patterson, 32-34 Frankfort street, New York.

Kennedy Valve Mfg. Co.

A very handsome catalogue illustrating the extra heavy patent gate valves and cast-iron fittings for high pressure steam work, indicator devices and blow-off valves, has just been issued by the Kennedy Valve Manufacturing Company, 75 John street, New York. The many admirable features of the gate valves manufactured by this company are ably set forth in the descriptive matter and the splendid wood cuts which are found in the circular. There are also shown gate valves for water-works service and other numerous requirements of steam, water, gas, ammonia, acid, oils, etc. The catalogue, which is handsomely bound, can be had on application to the above firm.

Phosphor-Bronze Smelting Co., Ltd.

These well-known manufacturers and sole makers of the "Elephant Brand" phosphor-bronze alloys have just issued a very complete catalogue and price list of their many phosphor-bronze products, such as wire of various shapes, rods, cast bolts, nuts, washers, nails, wire rods, sash chains and pens, as well as bars and bolts of any dimension. The catalogue contains numerous valuable tables of the weight, size and resistance of phosphor-bronze wires. They are also advertising in a separate pamphlet their well-known "Delta" metal, claimed to be the best forging bronze on the market, as strong as steel, and suitable for castings, stampings and forgings. The company will be pleased to furnish any further information of their products.

The Lakon Co.'s Transformers.

A very unique and interesting transformer catalogue has just been issued by the Lakon Company, of Elkhart, Ind., and is entitled "We Don't Do Anything Else." While every one knows that the Lakon Company people don't do anything else but make good and efficient transformers, still every one in whose hands this pamphlet comes will carefully read its pages. It tells about a dog which didn't do anything but smile, but that he did that one thing so well that he became a well-liked brute. So the company acknowledge their own ignorance on a multitude of subjects, but claim that there is one proposition on which you cannot lose them any place along the line, and that is on transformers, for they claim to know all about them from start to finish, and being pioneers on the subject, they say they ought to. The pamphlet, besides some very humorous illustrations, contains cuts of transformers, testimonials from users, and a price list. Still they claim that they don't tell you much, and if you drop them a card they will fairly flood you with information.

The Toledo Consolidated Electric Co.

One of the cleverest bits of central station advertising has just been forwarded to us by Mr. A. A. Atkinson, the contracting agent of the Toledo Consolidated Electric Company and Toledo Electric Company, of Toledo, O. It is a pamphlet entitled "The Evolution of Light," and contains beautiful half-tone illustrations of the various modes of lighting from time immemorial up to the present, associated with appropriate bits of poetry by Mr. Atkinson. It is most ingeniously and artistically prepared, and cannot but appeal to the user of light into whose hands it may come. Accompanying the pamphlet is Mr. Atkinson's card, on the back of which he requests the user of light to drop him a card or to telephone to him, so that he can call and advise with him as to the best light to use.

Ridgely & Johnson Tool Co.

The above company have just issued a very handsome catalogue of their valveless pneumatic tools for riveting, chipping, calking, chipping iron and steel castings, stone-cutting, carving and lettering. They address themselves to all users of pneumatic tools, and show by a large number of half-tone illustrations how their various tools are constructed and used. There are also shown several full-page cuts of buildings in the course of construction in which their large tools are used. The book has a very handsome cover, on which are embossed the words "Pneumatic Hammers" and the names of the Western sales agents, Jos. T. Ryerson & Son, 18 Milwaukee avenue, Chicago, Ill.

The American-Wheelock Engine Co.

One of the handsomest engine catalogues which has recently come to our notice has been issued by the above firm, located at Worcester, Mass., and whose agents are the Cramp-Hoadley Company, Postal Telegraph Building, New York City. This catalogue is of special interest to electrical engineers and central station men, as it contains a detailed description of the latest type of Green-Wheelock engine, with Hill valve gear. Ten principal advantages of this valve gear are enumerated in the catalogue, as well as the numerous medals and awards received by the company at various exhibitions. It contains also a number of illustrations, showing recent installations of the Green-Wheelock engine, as well as a number of high-duty com-

pound engine tests, which are both interesting and satisfactory. The catalogue will be sent to any one upon application.

Chas. P. Willard & Co.

In a very neatly arranged circular is described the well-known Willard water tube marine boiler for steam yachts and launches, which is claimed to be the lightest, safest and most economical boiler for such use. The circular contains several illustrations of the boiler, as well as reasons why the company believe their boiler to be the best. No fire brick is used in its construction, it has a ready separation of steam from water, there can be no accumulation of sediment in the drum, and the furnaces are large enough to burn any kind of fuel. Every foot of pipe in the Willard marine boiler is tested to 600 pounds hydrostatic pressure, and a certificate of the same is sent to the purchaser. The company is located at 15 North Canal street, Chicago, Ill., where all inquiries should be addressed.

De Veau & Co.

A pamphlet announcing their new 1898-99 catalogue and illustrating their various well-known telephone apparatus and supplies has just been issued by DeVeau & Co., 27 Rose street, New York. It contains, besides numerous illustrations of their apparatus, a cut of the exhibition booth of the company, as well as the editorial comments of the press on their factory recently opened.

ADVERTISERS' HINTS

THE KEYSTONE TELEPHONE COMPANY, 565 Old avenue, Pittsburgh, Pa., advertise instruments for long distance lines.

THE EDDY ELECTRIC MANUFACTURING COMPANY, Windsor, Conn., illustrate one of the direct-connected generating sets for lighting, railway and power transmission work.

THE AURORA ARC LAMP MANUFACTURING COMPANY, Pittsburgh, Pa., whose enclosed arc lamp is described on another page of this issue, will be pleased to send their catalogue of their various types of lamps, prices, etc.

THE WESTINGHOUSE ELECTRIC MANUFACTURING COMPANY, Pittsburgh, call attention to the various electric cranes they build, and illustrate their "ad." with one of their installations.

THE GENERAL ELECTRIC COMPANY are advertising lightning arresters, of which they have already sold a great many this season.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, Mass., have recently introduced a motor for small power purposes and which fastens on the edge of a shelf or table by means of a clamp. They are making them in sizes of 1-10 to 1-6 h. p. with a speed of 1,200 and 3,000 r. p. m. They are shunt or series wound and are adapted to be placed on 10 to 110-vole circuits.

THE SPRAGUE ELECTRIC COMPANY, 22 Broad street, New York, illustrate different styles of motors of the Lundell design.

NEW ENGLAND NOTES

THE BIBBER-WHITE CO., of Boston, have just bought out the business of the American Electric Company, of Boston, and will manufacture and market the New Era and other gas-light specialties formerly made by the latter company.

THE ELECTRIC GAS LIGHTING CO., of Boston, Mass., have recently built a 260-drop return call annunciator of the Ross style for the Indianapolis District Telegraph Company, to be installed in Hotel English, Indianapolis. This is one of a number of large instruments built by them this spring for hotels in different parts of the country. The company state that their output of annunciators has been exceedingly large the past few months, necessitating running their factory nights to keep up with their orders.

WESTERN NOTES

THE CENTRAL ELECTRIC CO., of Chicago, are pushing to the front a new stype of standard base 6 c. p. lamp. This lamp is made for standard voltages, is 3½ inches long over all and about 2 inches in diameter. It is exceedingly economical of current and will undoubtedly find large use for signs and other purposes where low candle powers are desired.

THE STERLING ELECTRIC COMPANY, of Chicago, Ill., on account of the rapid increase in their business, find it necessary to open a Southwestern office in St. Louis. Mr. H. A. Coit, formerly manager of the Missouri Telephone Company, and one of the best known men in the independent telephone field, will have charge of the Sterling Electric Company's business in that territory, carrying a full line of samples, and taking charge of their Southwestern business from his office, located in the Laclede building.

CONTENTS.

Department News Items will be found in advertising pages.

Electrical Engineer.

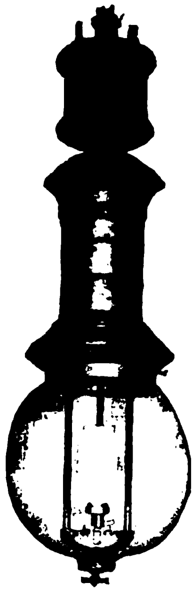
A WEEKLY REVIEW OF THEORETICAL AND APPLIED ELECTRICITY.

Vol. XXV. No. 505. NEW YORK, JANUARY 6, 1898. Price 10 Cents.

Press of THE CHEROUNY PRINTING AND PUBLISHING CO., 17-27 Vandewater St., New York.

IMPROVED ENCLOSED ARC LAMPS.

Highest Development in Mechanical and Electical Designs.



Weatherproof Lamp.

For Constant Potential Circuits.
Simplest Feeding Mechanism.

Best Device for Trimming and Cleaning Inner Globe, Reducing Breakage of Inner Globes to a Minimum.

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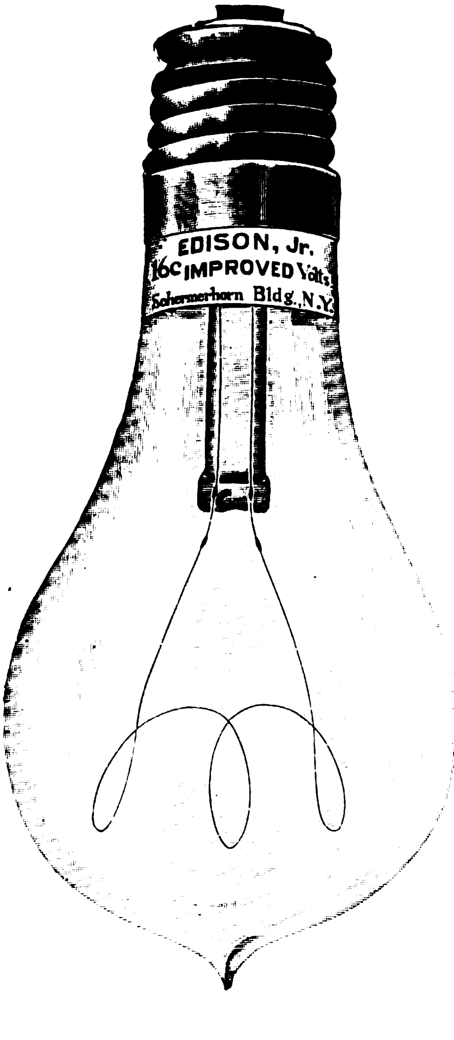

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ALPHABETICAL INDEX TO ADVERTISEMENTS.

FOR CLASSIFIED INDEX SEE NEXT PAGE.

CLASSIFIED INDEX TO ADVERTISEMENTS.

(Continued on Page X.)

CLASSIFIED INDEX TO ADVERTISEMENTS—Continued.

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Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.	Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03	Full	15.29	194 25	102.02	143.44	81.08
7/8	15.04	138.12	155.03	223.61	84.55	7/8	16.56	187.75	92.15	146.73	84.78
3/4	15.11	127.67	133.24	191.06	83.68	3/4	17.33	178.50	83.95	138.40	83.88
5/8	15.88	131.50	112.65	162.80	80.25	5/8	17.54	176.40	68.82	109.64	80.09
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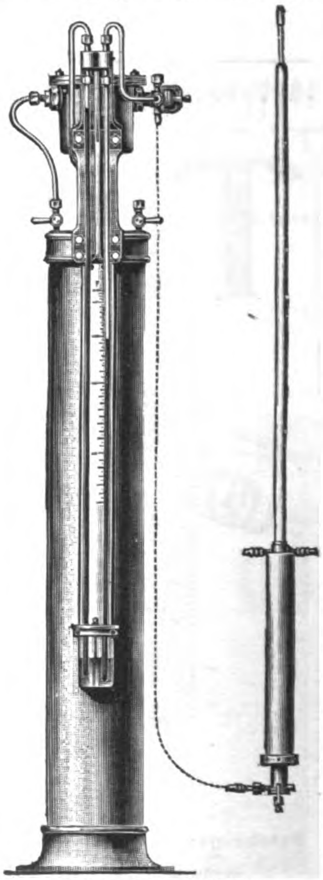

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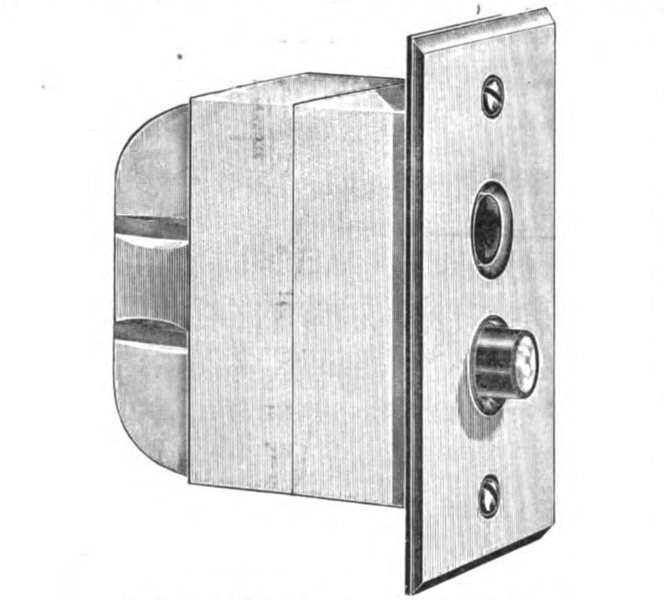

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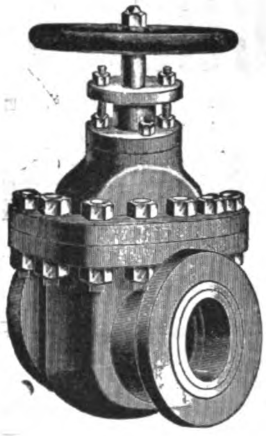

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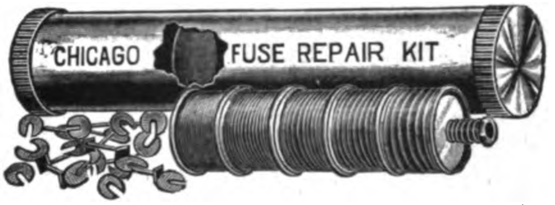

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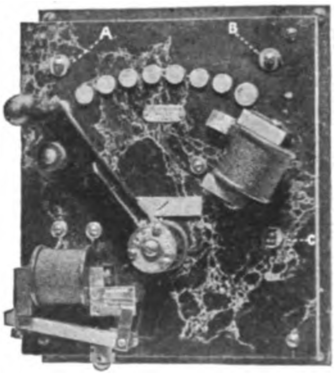

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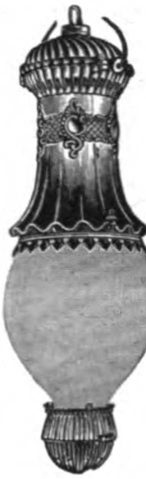

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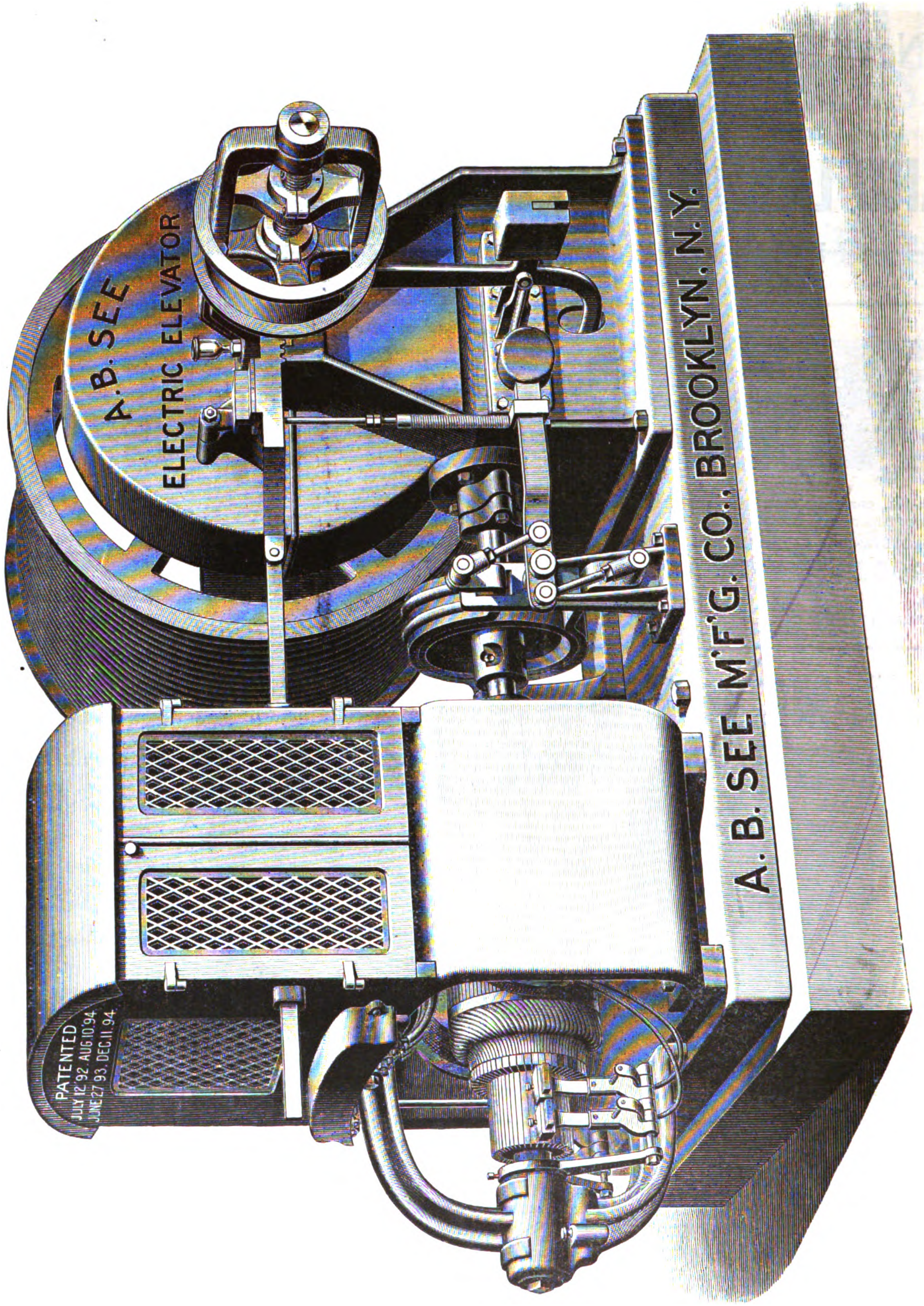
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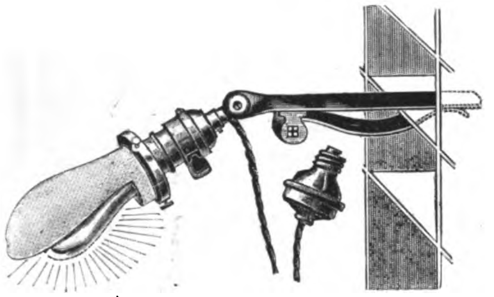

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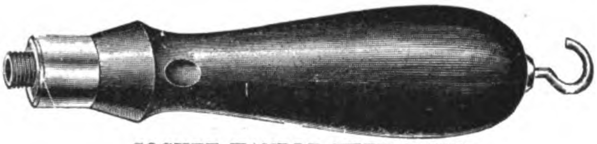

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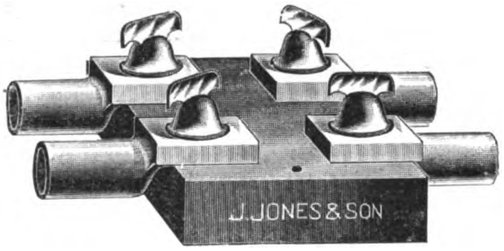

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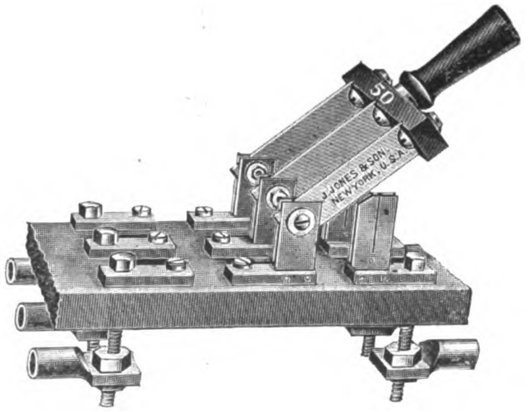

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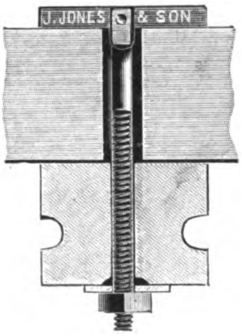

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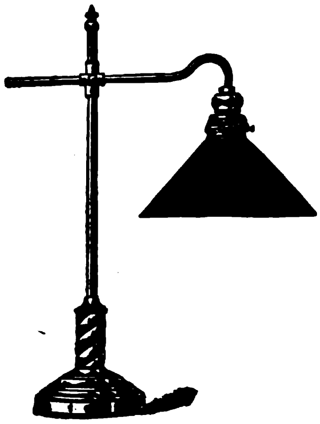

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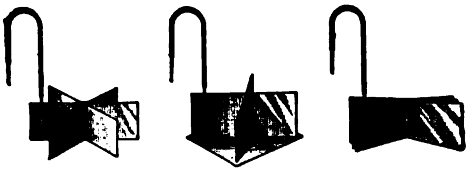

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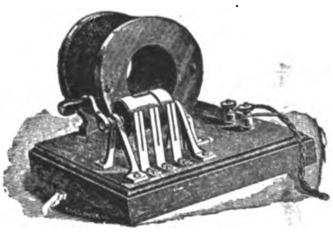

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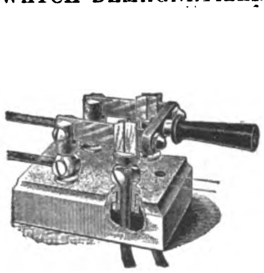

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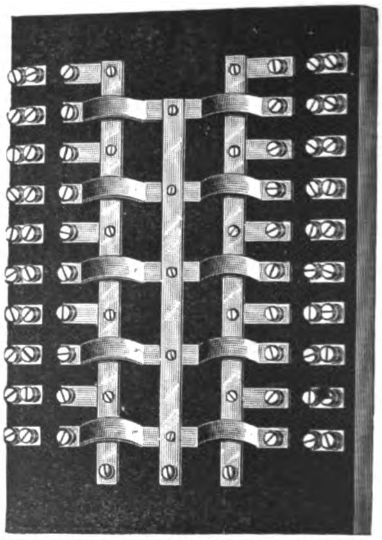

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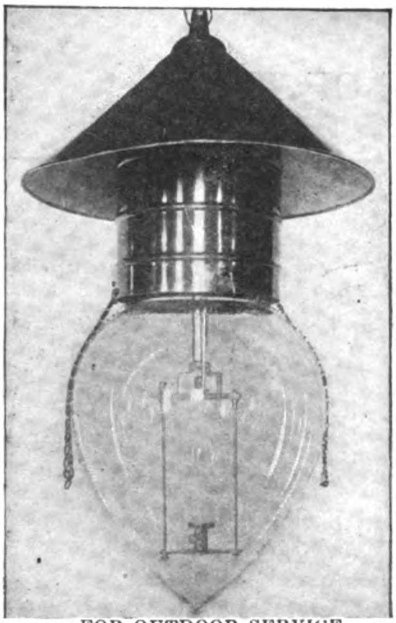

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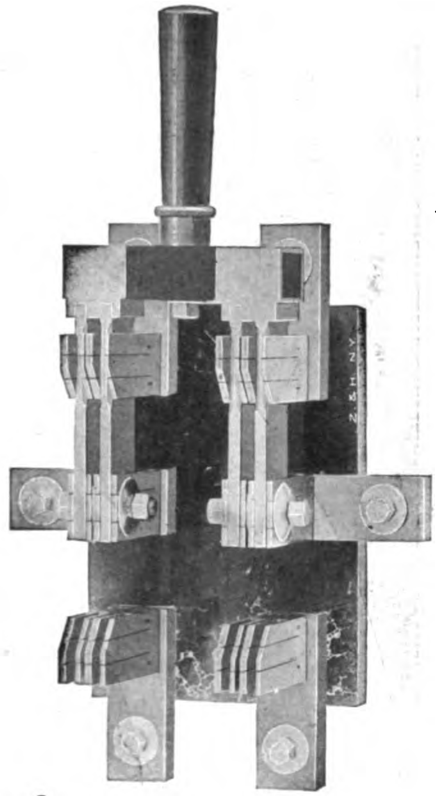

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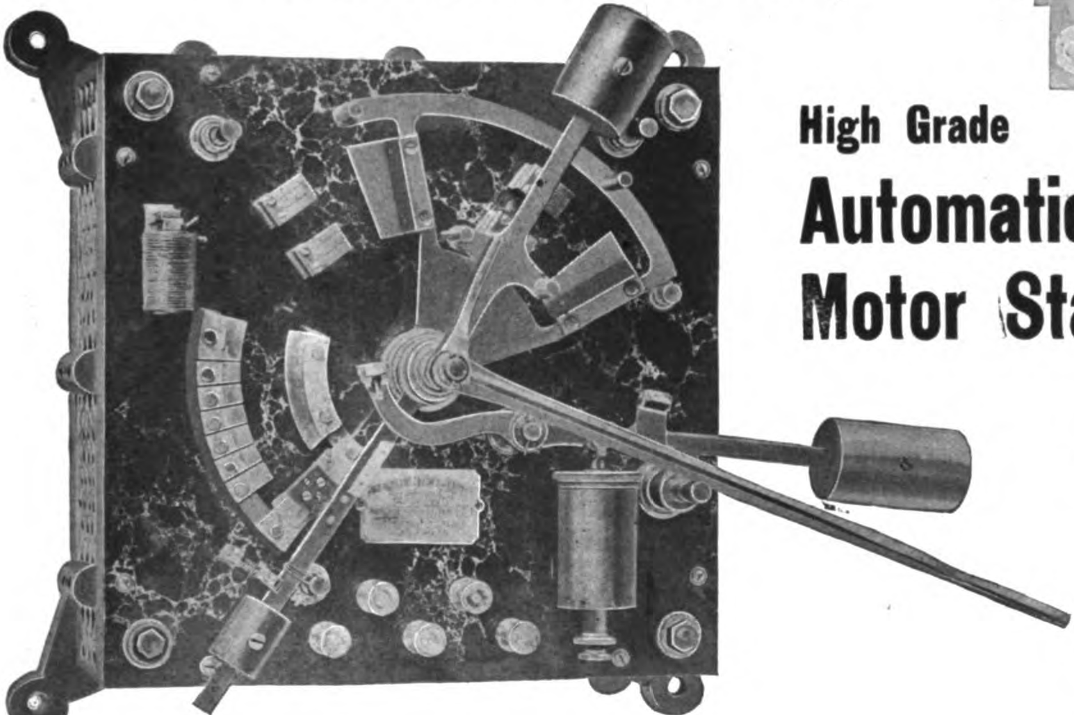

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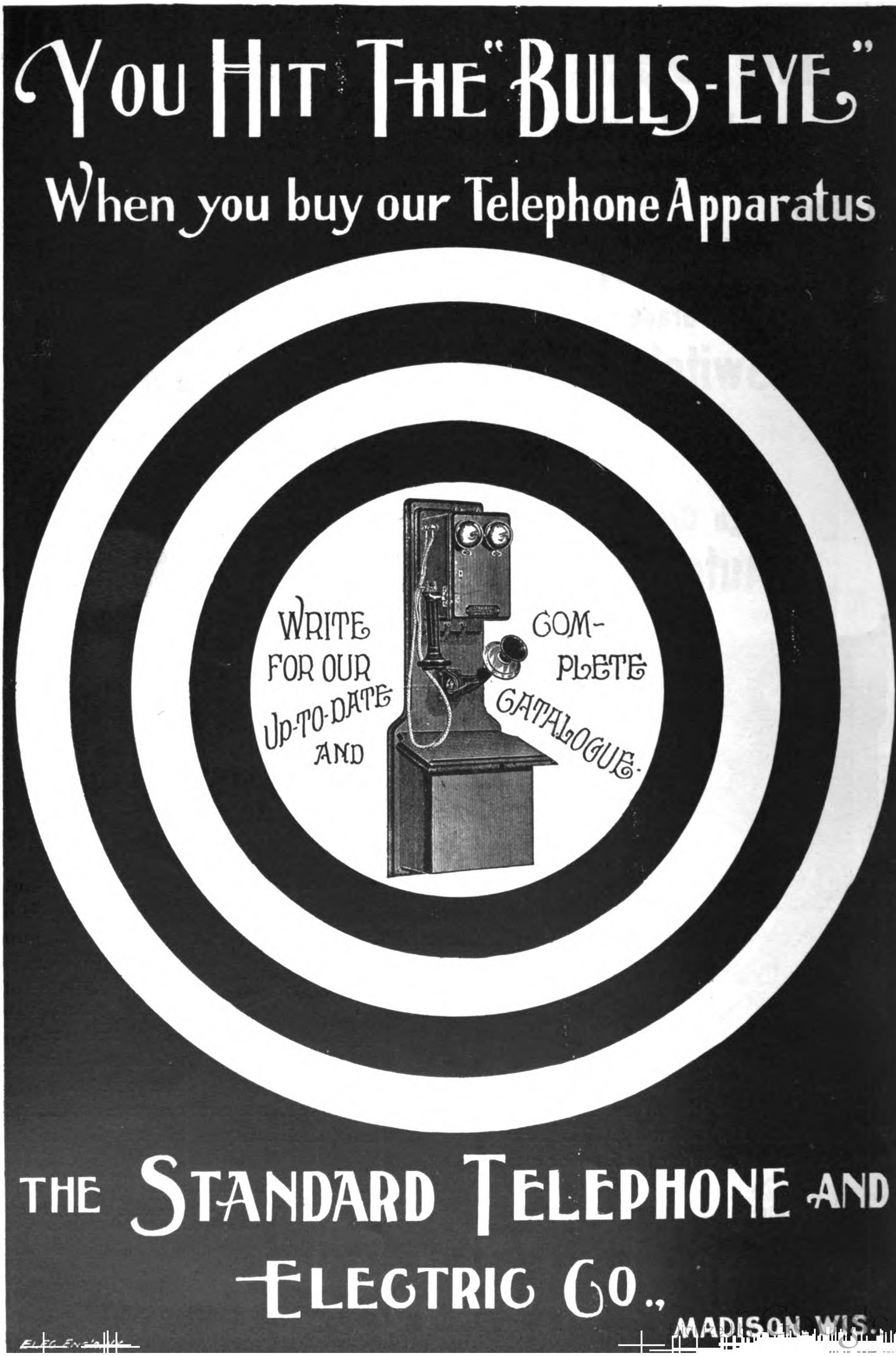
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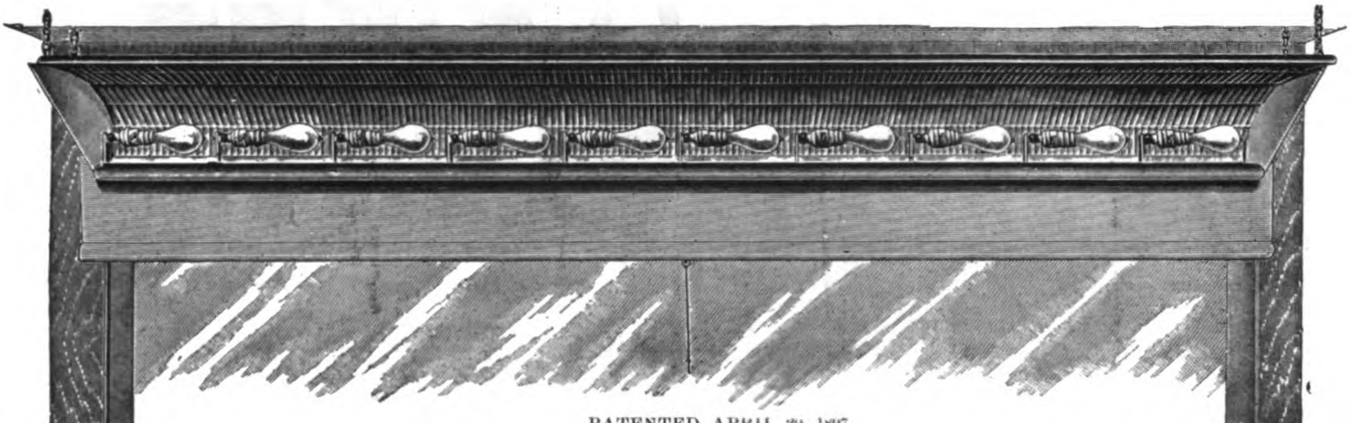

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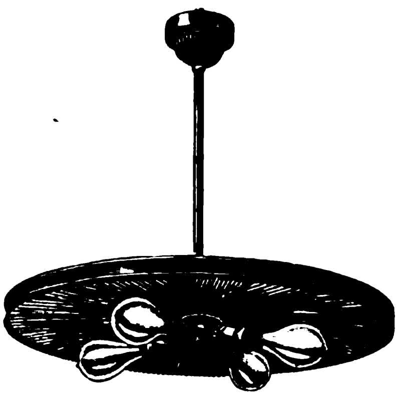

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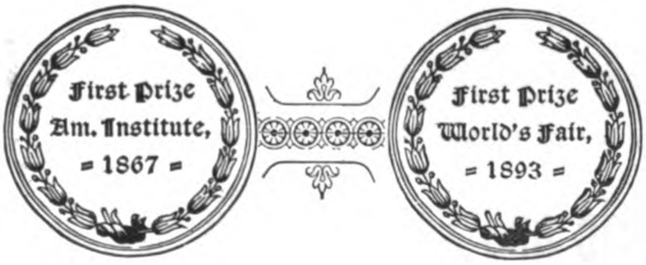

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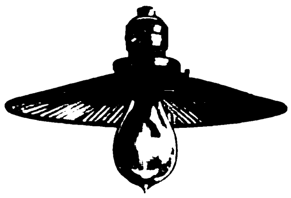

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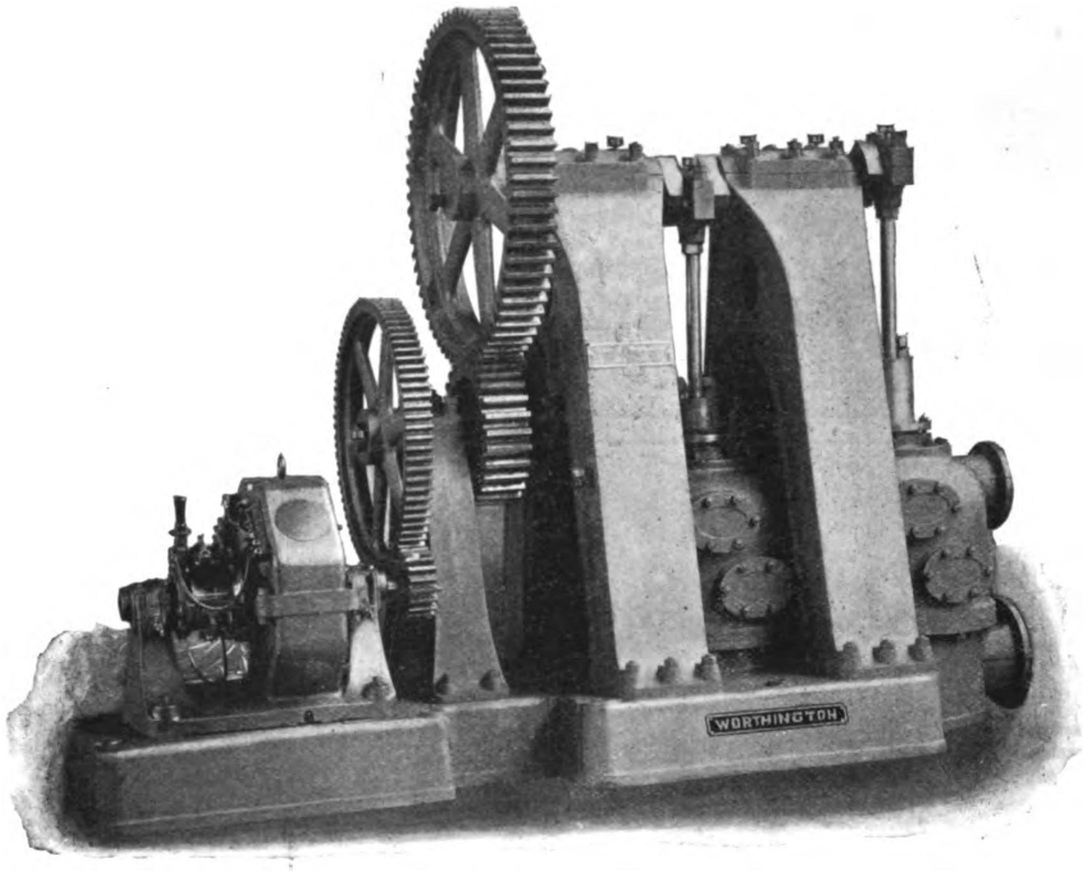

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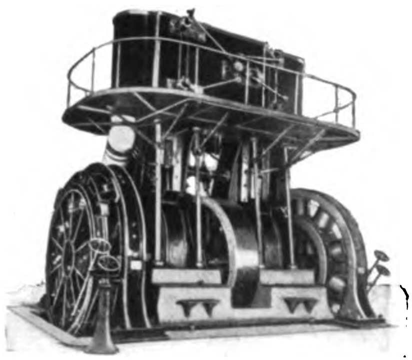

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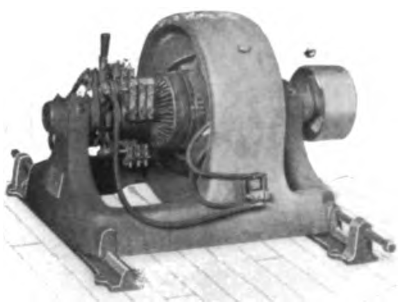

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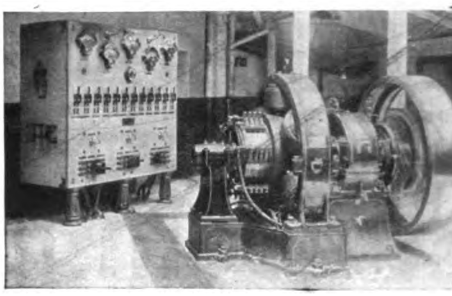


Isolated Plant, Custom House, N. Y. City.

The efficiency of its Air blast **transformers** is such that they are now in use in the principal long distance transmissions in this country. In the new **Type H transformer** new methods of construction render it the most perfect transformer on the market. The core loss is small, the insulation perfect, and the efficiency of the highest. Its use in place of older types has resulted in a marked increase of income at the switchboard.

General Electric Switchboard.

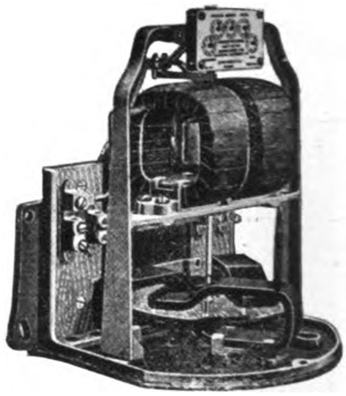
In the design of its **Switchboards** every effort has been made to attain simplicity and compactness without sacrificing any of the features essential to perfect operation. The introduction by it of the panel type **generator and feeder switchboard** allows of uniform increase of the board with any increase in the station. Each device with which each board is equipped has been the subject of the most careful design, and each is a perfect piece of apparatus in itself. The accuracy of the **Thomson Recording Watt Meter** has made it the most widely used meter of the present day. Built for alternating current or direct current lighting circuits, two or three wire, for power circuits, railway circuits, both in the station or on the car, and for storage battery use, they are made in capacities ranging from five to eight thousand amperes.

Air Blast Transformer.

Type H. Transformer.

Recording wattmeters for measuring the total output of any station are also built by the **General Electric Company.**

The **Thomson inclined coil instruments for switchboard, portable and pocket use** devised to supply a demand for trustworthy instruments at reasonable prices, fill every requirement of commercial use. Substantial in construction, with no parts liable to injury or alteration from use, they may be relied upon as accurate. While intended primarily for alternating current measurements, they may be used on direct current circuits where extreme accuracy is not required. The inclined coil instrument has also been adapted for use on series arc circuits.



Thomson Recording Wattmeter.

In **General Electric Rheostats** each unit of resistance is a German silver wire or ribbon wound on an asbestos tube, flattened and creased and then clamped to plates. They are incombustible, completely insulated, almost impossible to injure and easily repaired. The motor starting rheostats are built with automatic switch.

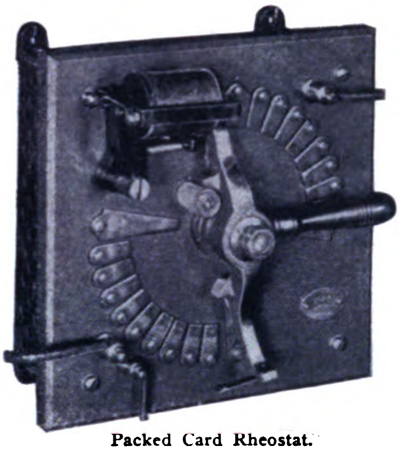
Thomson Inclined Coil Ammeter.

Standard General Electric single-phase and three-phase induction motors, for 60 cycles and 125 cycles, possess a considerably higher power factor than those of any other make, while in efficiency and speed regulation they excel all others. The construction is

Inclined Coil Pocket Ammeter.

unusually substantial and as there are no moving contacts, flashing, sparking or burn-outs are practically impossible.

The **General Electric Company** manufactures **enclosed and open arc lamps** for constant current, constant potential, alternating current, railway and power circuits. Its open series arc lamps have been the standard for years, the other types since the date of their introduction. The economy in carbons, the quality of the light and the safety and simplicity of the mechanism of its enclosed arc lamps for alternating, as well as for direct current service have already established a phenomenal record. For low ceilings its single solenoid enclosed lamp is suitable; for ship and dock use its marine enclosed lamp is now generally used. These lamps are manufactured in a large variety of ornamentation and finish.

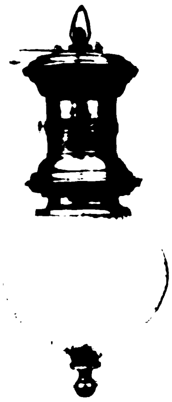


Packed Card Rheostat.

Fifty distinct operations and forty separate tests and inspections are required in the manufacture of the **Edison Incandescent lamp.** The omission of no detail of manufacture and test, the longest experience and the largest production render the Edison lamp the superior of all incandescent lamps. The candle power standard is the highest employed, and no lamp is overrated: both ratings and standards are reliable. Its processes embody all the improvements that careful judgment and long experience show are necessary to the manufacture of a finished lamp of highest quality. The **Edison lamp is absolutely unequalled — the standard of the World.**

Induction Motor.

Electric lighting, railway and power supplies of all kinds—sockets, switches—snap, knife and quick break,—fuses and fuse-holders, cut-outs, both link and plug, automatic circuit breakers, lightning arresters, insulators, railway frogs, crossings, etc., are manufactured by the **General Electric Company,** each device carefully designed for the work to be done. It manufactures its own porcelain, and its own insulation, and guarantees their perfection. It manufactures also **wires** and **cables** for all purposes—aerien, subterranean or submarine.

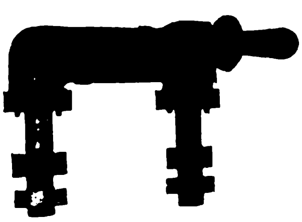


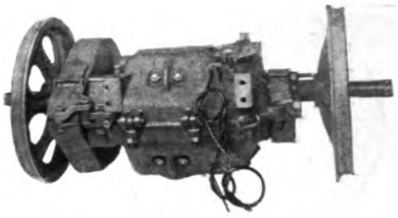
Alternating Current Enclosed Arc Lamp.

The **General Electric Company** manufactures complete electrical equipments, not only for the largest central stations, but, also, for isolated plants however small. It manufactures complete equipments for light and power plants for council-halls, hotels, theatres, apartment houses, office buildings, etc., as well as for men-of-war, steamships, yachts, docks and wharves. Its marine wiring appliances have been developed to meet the most stringent naval requirements, and the outcome of years of experiment has resulted in the production of electric searchlights equal to any from the best European workshops.

Edison Incandescent Lamp.

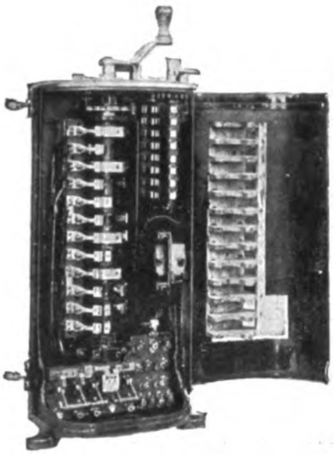
The **General Electric Company** first constructed commercially practical electrical machinery for operation in both coal and metal mines, each device specially designed to suit the special conditions prevailing in mine work. Electric locomotives, hoists, pumps, ventilators, etc., of its manufacture are now satisfactorily and economically working


Quick Break Switch.


G. E. 52-Motor on Axle.

in almost every mining centre in the United States, as well as in many foreign countries.

Devoting its attention to the Long Distance Transmission of Power by Electricity, the **General Electric Company** has done more than any other to render the waste powers of nature available to human use. The longest commercial transmission at the highest voltage yet employed has been carried out by it, and not less than one hundred thousand horse-power of its apparatus is now in use in purely long distance transmission work. Each special problem, as it has arisen, has been successfully solved, and to-day, in Long Distance Transmission of power by electricity, the apparatus of this company and the systems employed stand without a rival.


K_2 Controller.


Mining Locomotive.

General Electric Railway motors and controllers are the standard by which all other makes are measured. The pioneer in the electric traction industry, the **General Electric Company** is still the first and foremost. It manufactures railway motors of all sizes from the small mining locomotive motor to the huge motors on the Baltimore & Ohio electric locomotives. Its long experience in the railway field enables it to undertake the complete equipment of any street, elevated, interurban or steam railroad for electric traction.

The General Electric Company is the only company in the world which itself manufactures every electric device necessary in electric lighting, power, railway, mining or long distance transmission work.

Sales Offices:

BOSTON, MASS., 180 Summer Street.

NEW YORK, N. Y., 44 Broad Street.

SYRACUSE, N. Y., Sedgwick, Andrews & Kennedy Bldg.

BUFFALO, N. Y., 901 D. S. Morgan Building.

PHILADELPHIA, PA., 509 Arch Street.

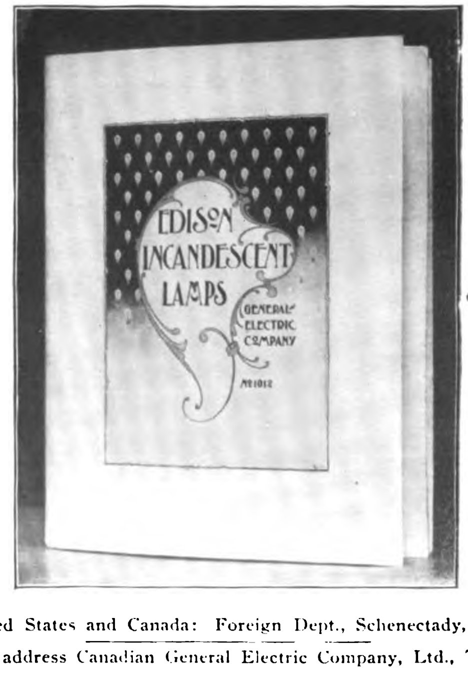
BALTIMORE, MD., 227 E. German Street.

PITTSBURG, PA., 502 Tradesman's Bank Building.

ATLANTA, GA., Equitable Building.

NEW ORLEANS, LA., 423 Baronne Street.

CINCINNATI, O., 420 West Fourth Street.



Sales Offices:

COLUMBUS, O., 14 North High Street.

NASHVILLE, TENN., 308 North Summer Street.

CHICAGO, ILL., Monadnock Building.

DETROIT, MICH., Commercial Bank Bldg.

ST. LOUIS, MO., Wainwright Building.

DALLAS, TEXAS, Junction Building.

HELENA, MONT., Electric Building.

MINNEAPOLIS, MINN., Phoenix Building.

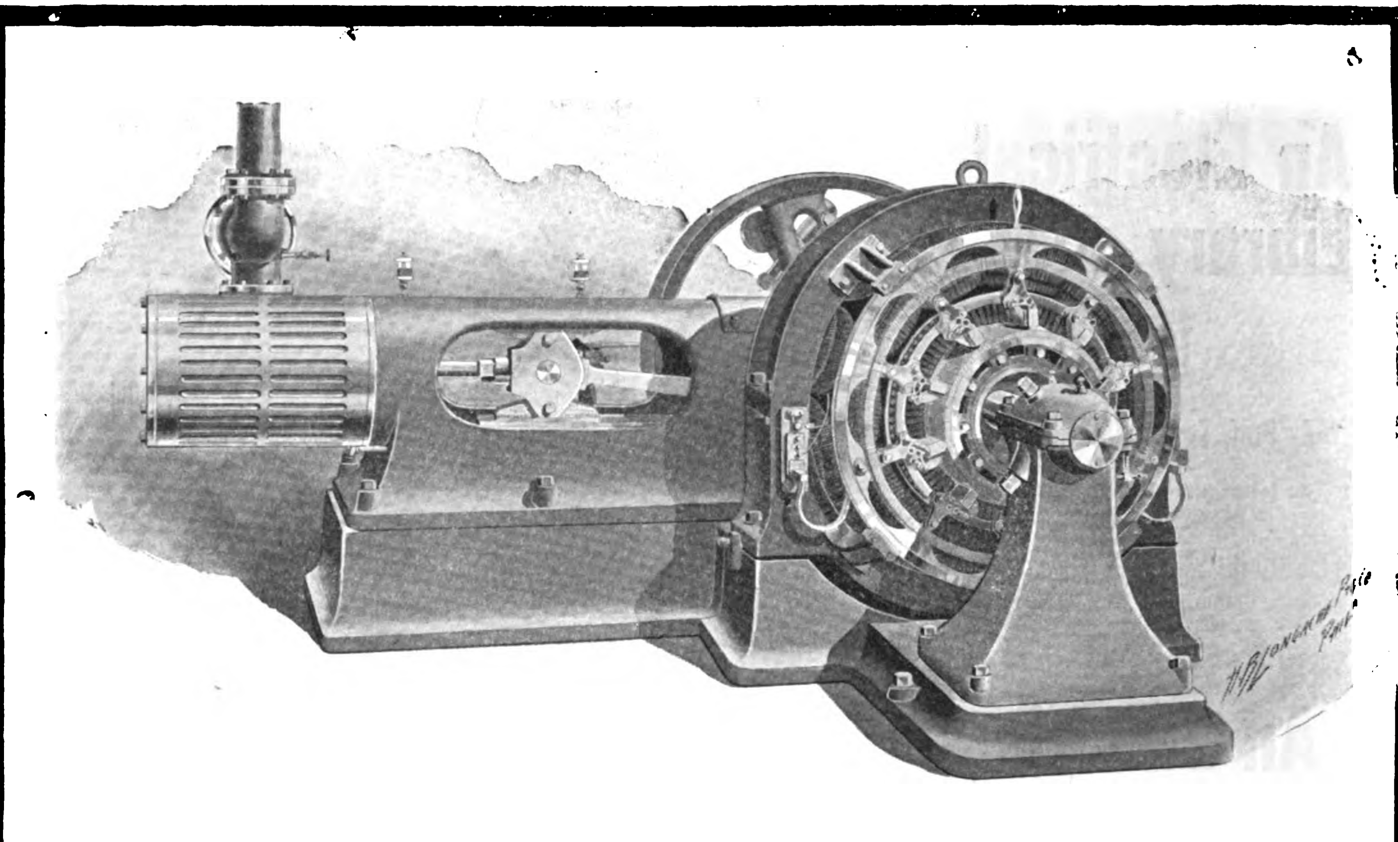
DENVER, COL., Kittredge Building.

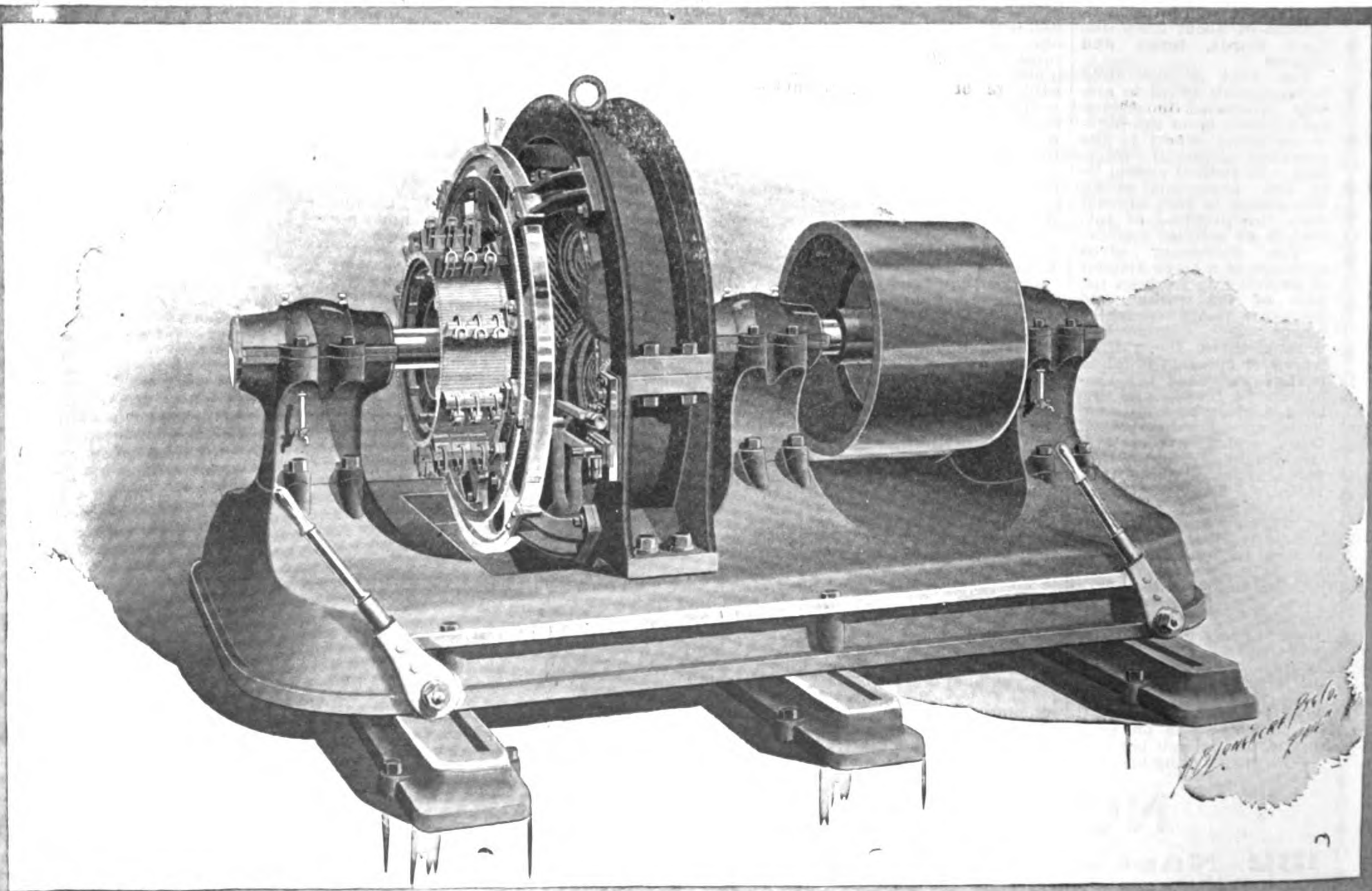
SAN FRANCISCO, CAL., Claus Spreckels Building.

PORTLAND, ORE., Worcester Building.

For all business outside the United States and Canada: Foreign Dept., Schenectady, N. Y., and 44 Broad Street, N. Y.

For Canada, address Canadian General Electric Company, Ltd., Toronto, Canada.





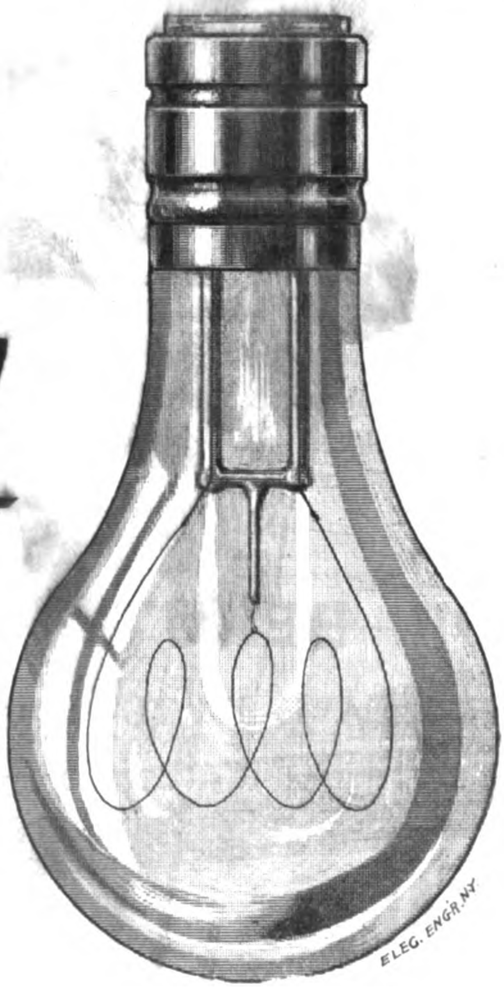
LAMPS

A BLIND MAN CANNOT SEE.

But anyone who is conversant with the various makes of INCANDESCENT LAMPS and their WEAK POINTS

CAN SEE AT A GLANCE THAT THE ...220 VOLT...

SHELBY LAMP



FULL SIZE.

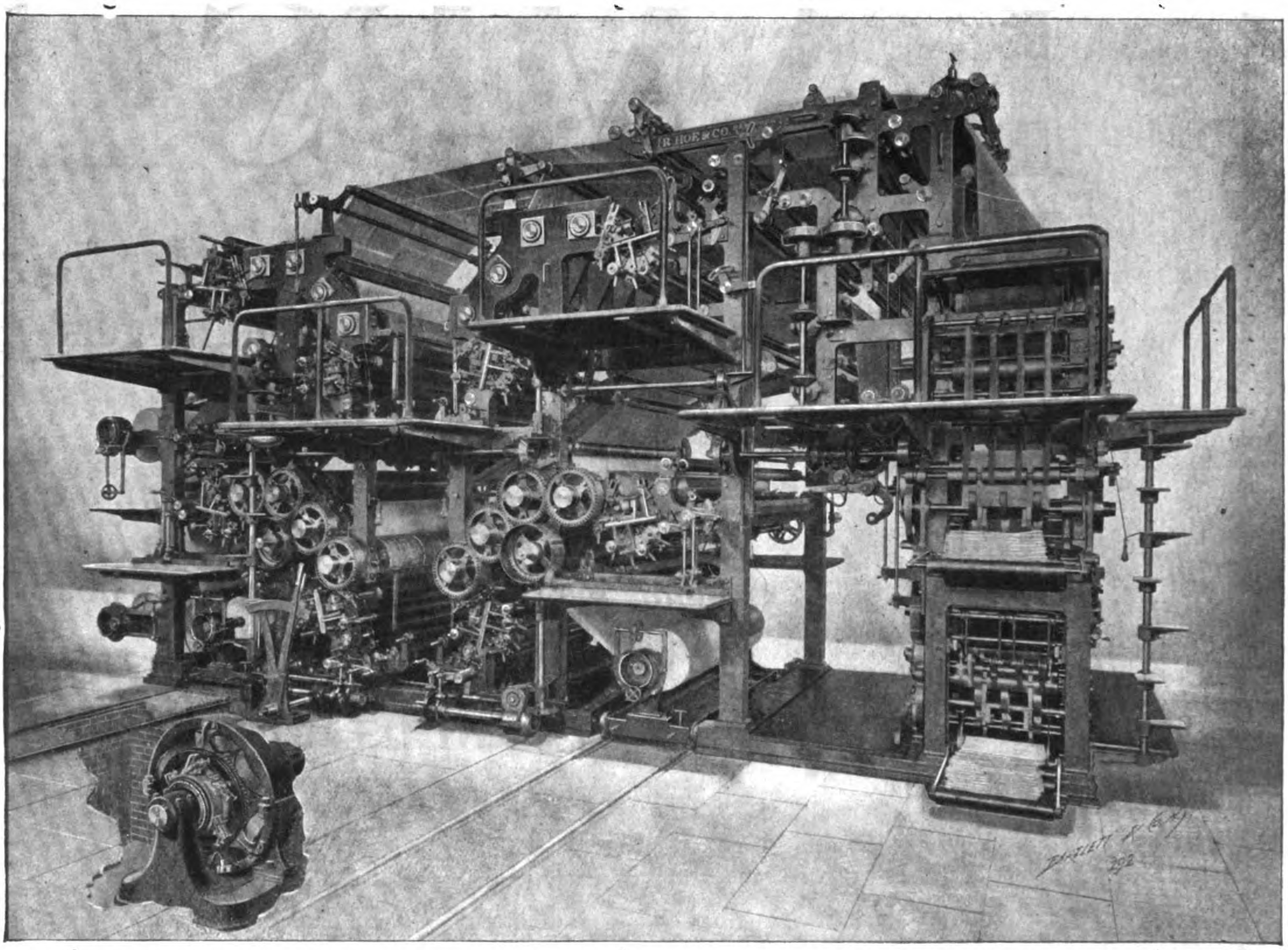
HAS ADVANTAGES OTHERS DO NOT POSSESS.

THEY CANNOT BLOW. THEY CANNOT SHORT CIRCUIT. THEY CAST NO SHADOWS.

THEY ARE BETTER AND STRONGER.

"A THING OF BEAUTY IS A JOY FOREVER."

THE LARGEST PRINTING PRESS EVER BUILT.—DRIVEN BY A CROCKER-WHEELER MOTOR.



OCTUPLE STEREOTYPE PERFECTING PRESS AND FOLDER, BY R. HOE & CO. Prints, Folds, Counts and Delivers 96,000 8-page newspapers per hour.
75 H. P. CROCKER-WHEELER MOTOR DIRECTLY CONNECTED UNDER FLOOR.

DIRECT TYPE MACHINES for direct-connected Dynamos and Motors to displace driving pulleys on printing presses, blowers, pumps, etc.

BELT TYPE MACHINES of Highest Efficiency, either as direct-current dynamos or motors. We wind for special speeds and voltages to suit customers.

MOTOR-DYNAMOS, DYNAMOTORS and BOOSTERS for telegraph lines, charging storage batteries, electroplating, electric cautery, etc., and raising potential at end of feeders.

MILL MOTORS, completely iron clad, for work in Rolling Mills, Foundries, etc.

CROCKER-WHEELER ELECTRIC CO.

WORKS: Ampere, Newark, N. J.

MAIN OFFICE: 39 Cortlandt St., N. Y.

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1515 Old Colony Building, Chicago.
14 South Broad St., Philadelphia, Pa.
Bibber-White Co., 49 Federal St., Boston, Mass.
Blackall & Baldwin, 39 Cortlandt St., N. Y.
Laclede Power Co., St. Louis.

Geo. H. Stout, Cincinnati.
Bissell, Dodge & Erner Co., Toledo.
Bissell, Dodge & Erner Co., Columbus.
J. L. Alberger & Son, Buffalo.
Cleveland Electrical Mfg. Co., Cleveland.
Rudolph Schmidt & Co., Rochester.

Electrical Engineering & Supply Co., Charlotte, N. C.
Zamoiski-Palmer Co., Baltimore.
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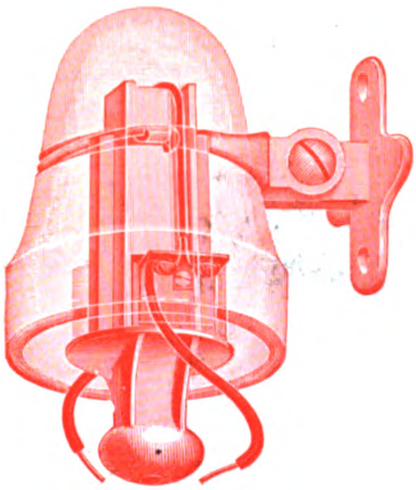
THE "BRODIE"

Single-Pole Primary Switch AND Cut-out

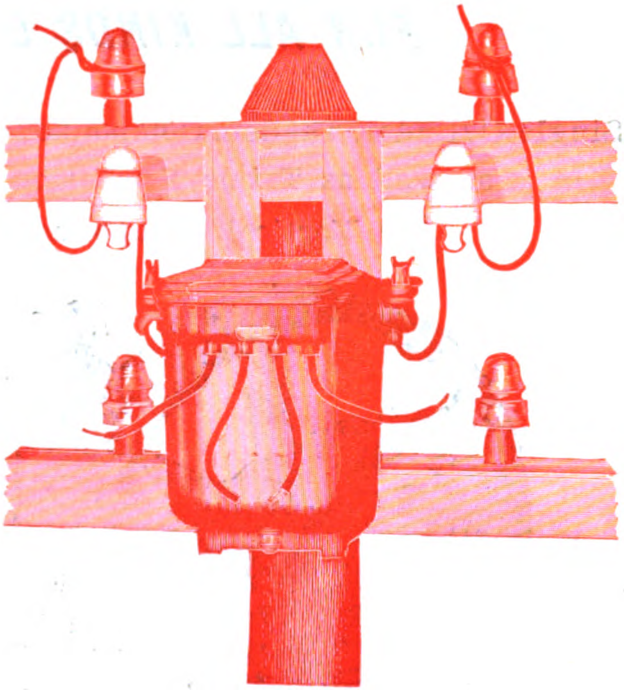
FOR HIGH TENSION CURRENTS.

For use with transformers and in general outside construction work.

Cannot Possibly Short-Circuit.



DETAIL VIEW.



SHOWING FUSE-BOX IN USE.

EASILY PUT UP AND WIRED.

Instantly and safely re-fused when blown with interchangeable fuse plug securely locking in position.

MADE ENTIRELY OF PORCELAIN.

AND BEST OF ALL, **CHEAP.**

Ask your dealer for it or order direct from

The Brodie Electric Co.,

No. 886 Elm St., Manchester, N. H.

A Happy New Year

And remember that good resolution to lay in a complete stock of Anchor Switches for 1898. True happiness comes from satisfaction, and satisfaction comes from using Anchor Switches; so take timely warning and "fill up" for the New Year. You'll soon get rid of them. They go fast. No cobwebs on Anchor Switches. Our catalogue on request.

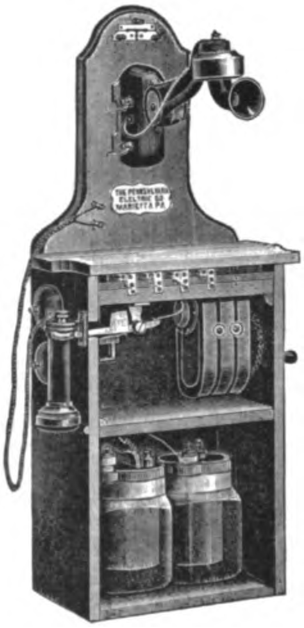
ANCHOR ELECTRIC CO.,

71 Federal St., Boston.
Chicago: Monadnock Block.

THE CRESCENT TELEPHONE

IS A HIGH GRADE TELEPHONE. STRICTLY UP-TO-DATE.

Patent applied for.



Patent applied for.

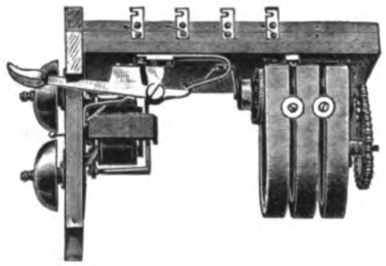
Patent applied for.

SEE

HOW EASY

FOR

THE TROUBLE SHOOTER



Patent applied for.

WRITE FOR DESCRIPTIVE MATTER.

PENNSYLVANIA ELECTRIC CO., MARIETTA, PENN.

INSULATING...

COMPOUND

...Black, Brilliant and Elastic.

Also WAXES of all kinds.

W. H. BOWDLEAR & CO.,

149 Pearl St., BOSTON.

Factories at Williamsville, Mass.

Dynamo & Motor Brushes

WOVEN WIRE GAUZE, COPPER LEAF, BRUSH & T. H. ARC, "WIRT,"
PARTRIDGE SELF LUBRICATING CARBONS.

H. M. SHAW & CO.,
Manufacturers and Dealers.
126 Liberty Street. NEW YORK.

STANLEY ELECTRIC MFG. CO.,

PITTSFIELD, MASS.

WESTERN OFFICE: 1506 Marquette Bldg., Chicago, Ill.
THE ROYAL ELECTRIC CO., MONTREAL, CAN., are exclusive licensees for the manufacture of the S. K. C. System in the Dominion of Canada.
St Louis, Mo., Western Electric Supply Co.
See page xix. of this issue.

"The Niagara"

Electric Freight and Passenger Elevator

"Will meet the most exacting conditions" of "Speed, Load and Rise," on either "Direct, Alternating or Phase Circuits."

(PATENTS APPLIED FOR.)

Address,

ARMITAGE-HERSCHELL CO.,

NORTH TONAWANDA, N. Y.

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COLT & Co
MANUFACTURERS OF
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MANIPULATION OF LIGHT
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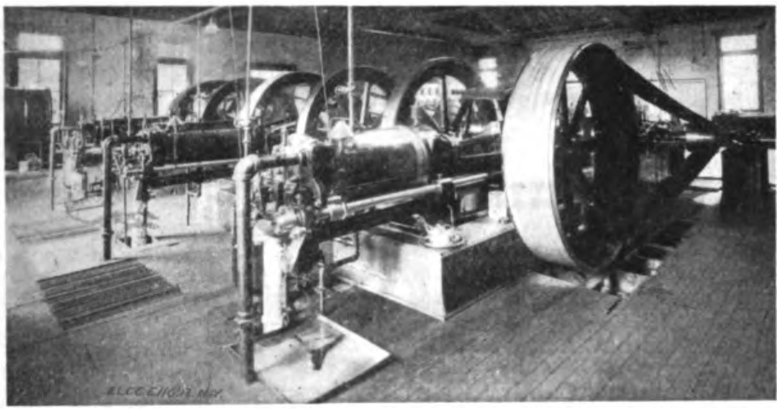
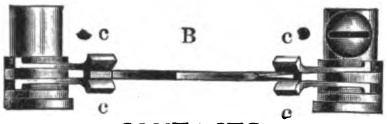
THEATRE LENS AND COLOR WHEEL
BALCONY LIGHT
ACETYLENE GAS BURNER
NAPHEY'S ACETYLENE GENERATOR FOR HOUSE LIGHTING
ACETYLENE LANTERN
"CRITERION" ELEC LANTERN
ELEC. ENGR. N.Y.



Are You Buying Switches

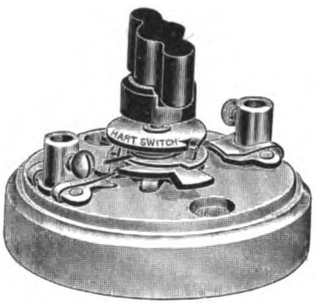


CONTACTS

in these Switches are now this "double-contact" or "Knife Switch" form.

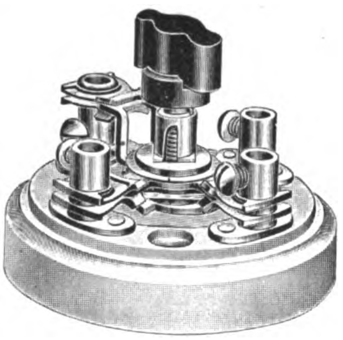
After several years experience it has been found that this is the safest and most durable, and the only one that should be used with currents of more than five amperes.

See our catalogue, page 3.



HART 5 AMP. S. P. SWITCH

See our catalogue, page 4.



HART ELECTROLIER SWITCH

For controlling the lamps on an electrolier in sections.

See our catalogue, page 8.

DIMMER SWITCH

Used when a dim light is required at times.

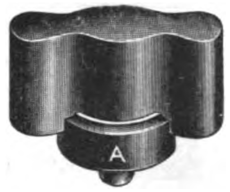
See our catalogue, page 11, for full description and method of wiring.

HART SNAP SWITCHES

Some makes of switches are better than others. No switch is too good for the work required from it. Your circuits must be kept equipped with switches in working order. Whether it is better to buy a good and durable switch in the first place or to buy an inferior switch, simply because first cost is a few cents less, is for you to decide. If you buy inferior switches that do not last, you are simply equipping your circuits with switches on the installment plan—each payment of the installment being almost equal to the full price of a reliable switch.

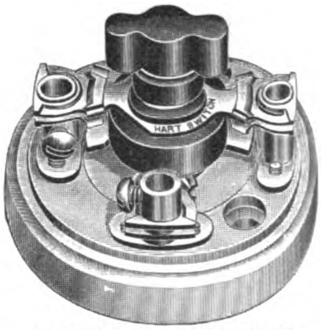
When we say that experience has proved Hart Switches to be the best and cheapest, we do not ask you to accept our statement, but want to call your attention to the matter and lead you to investigate. It is sometimes more satisfactory to investigate beforehand. The following is an instance:

Willie and Johnny set up a lemonade stand.
Willie's sign read:
"Four cents a glass."
Johnny's read:
"Two cents a glass."



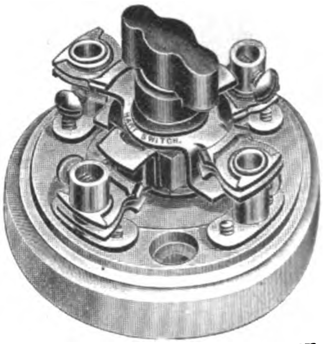
HART PATENT SELF-ADJUSTING HANDLE.

The Collar A is pressed downward by a spring, thus holding cover firmly but without friction.
See our catalogue, page 3.



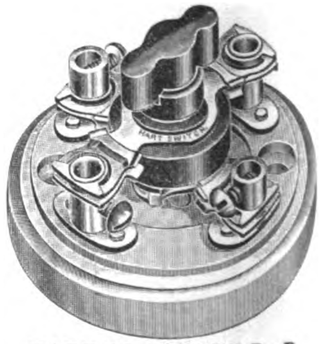
HART 3-WAY SWITCH.

For Controlling a group of lights from either one of two points.
See our catalogue, page 6, for wiring diagram, etc.



HART 4-WAY OR COMMUTATION SWITCH.

For controlling a group of lights from 3 or more points.
See our catalogue, page 7, for wiring diagram, etc.



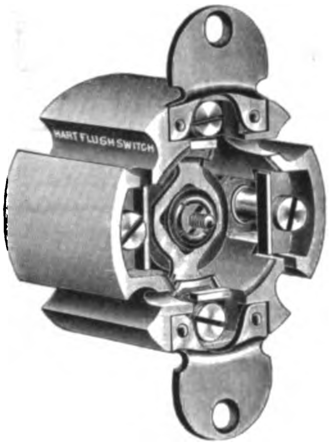
HART 10 AMPERE D. P. **SWITCH.**

See our catalogue, page 9.

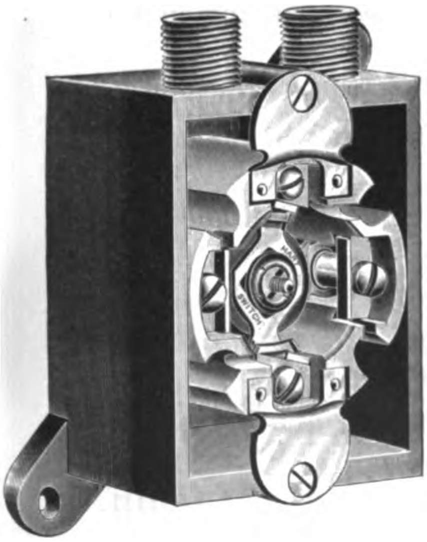
THE HART & HEGEMAN MFG.

on the Installment Plan?

Hart Flush Switch Complete With Plate.
See our Catalogue, Page 13.



Hart Flush Switch with Plate removed.
See our Catalogue, Page 14.



Hart Flush Switch in Iron Box.
See our Catalogue, Page 25.

A customer came along, bought and drank the two cent lemonade from Johnny, and then decided to investigate reason for difference in prices.

"Why is your's cheaper than your brother's?" he asked. The reply was:

"Cos mine is the lemonade that the puppy fell into."

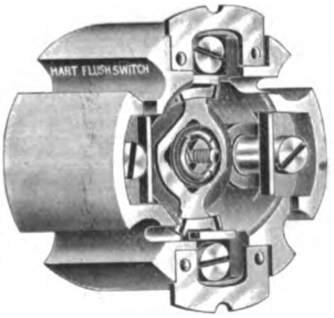
Hart Switches have been before the public since 1890. Our sales to-day are larger than ever before. Many central stations and leading contractors use our switches exclusively. There must be a reason for this.

Hart Switches are made in large quantities and, therefore, cost of manufacture is reduced as much as possible. Our prices are fair and reasonable.

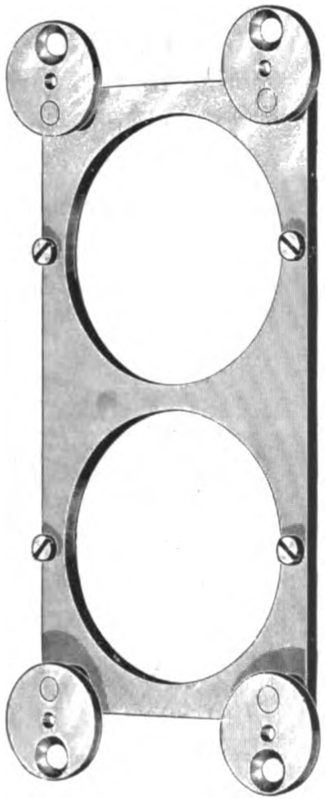
To guard against imposition on our customers and ourselves, all genuine Hart Switches have the words "Hart Switch" stamped in the metal. Any switch not so stamped was not manufactured by us and is not a Hart Switch.

Our illustrated catalogue, containing 30 pages of interesting and valuable information, wiring diagrams, etc., will be mailed free, on application, to all switch users. Any information regarding switches will be cheerfully furnished.

All leading Supply Houses carry our switches in stock and can fill orders without delay.



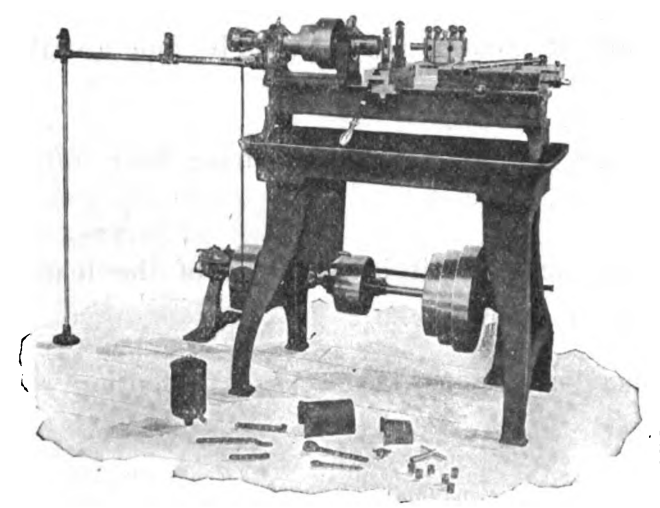
Hart Gang Switch.



Hart Gang Plate. Back.
See our Catalogue, Page 16.

Hart Gang Plate. Front. See our Catalogue, Page 17.

CO., HARTFORD, CONN.



No. I Screw Machine, Wire Feed. Capacity, 5/8 inch.

SCREW MACHINES.

Wire Feed or Plain.
51 Styles—7 Sizes.

MILLING MACHINES.

Plain, Duplex, Hand, Universal,
Lincoln, Vertical. All Sizes.

...LARGEST MACHINERY STORE IN AMERICA.

Most complete stock of Machinery and Machine Tools

IN STOCK FOR IMMEDIATE DELIVERY:

Lathes, Planers, Shapers, Drill Presses, Radial Drills, Gear Cutters, Cutter Grinders, Grinding and Polishing Machines, Profilers, Tappers, etc.

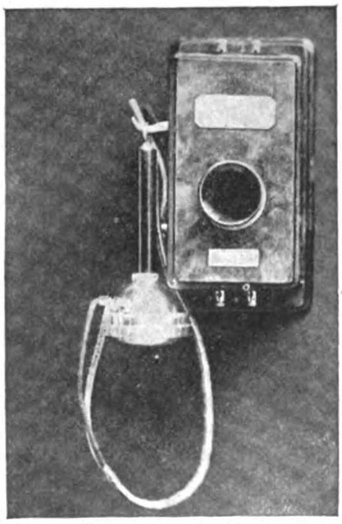
Complete Plants Equipped for Manufacturing Electrical Goods.

Send for Catalogue.

The... Garvin Machine Co.,

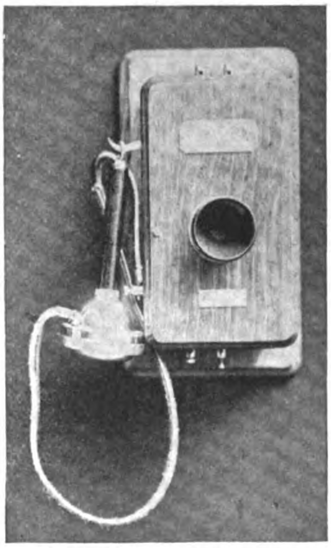
Spring and Varick Sts.
NEW YORK.

PHILADELPHIA STORE,
51 N. 7th St., Philadelphia, Pa.



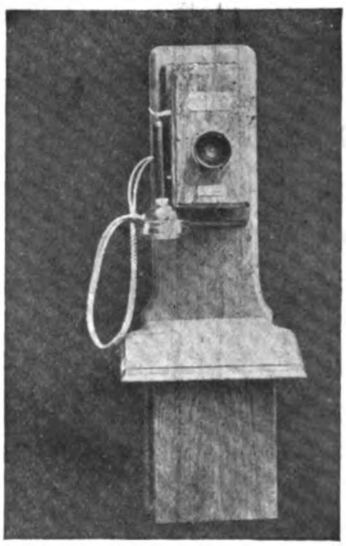
Cosmo, No. 1, $5.00.

"**The Cosmo**" No. 1 will signal and talk as far as any instrument, carbon ball transmitter never requiring adjustment; tone qualities are distinct with lips close to it, or you may stand away 20 feet and the transmitter will still work perfectly. **Particularly adapted to long-distance private line and inter-communicating systems,** but not to ringing bells or working drops.



Cosmo, No. 2, $6.50.

"**Cosmo**" **No. 2** is same as No. 1, except that it is adapted to work drops and ring polarized bells, and is therefore, **a perfect instrument for small exchange use as well as party lines.** In series or in multiple. Has no backboard or battery-box attached, batteries being placed on floor or adjoining closet or shelf.



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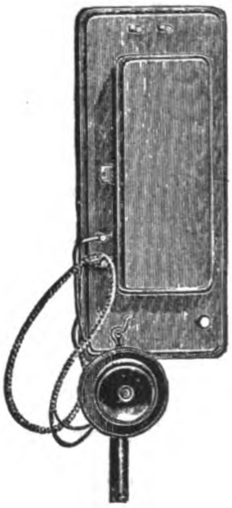
"**Cosmo**" **No. 3** is our regular **Exchange 'Phone;** backboard and batteries attached; complete in itself; it will ring bells, work drops, and in fact do anything required of it.

We make either "Cosmo" No. 2 or "Cosmo" No. 3 with a harmonic signal instead of the bells, also adapted to work drops and for use in Exchange systems, and another form to ring bells and work drops without a harmonic system.



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"**Harmonic**" **No. 1** has a magneto adapted to be used as a transmitter or receiver; will talk and signal from 50 to 100 miles on a double copper circuit; has our new signal device. When desired we can attach an independent transmitter to it, which increases the price to $4 each.

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OPERATED WITHOUT ELECTRIC BATTERIES.

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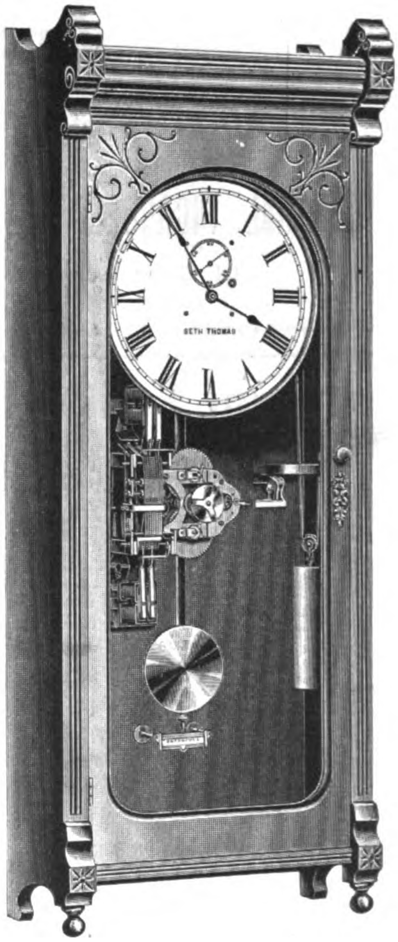
6. **It is cheaper** than any other electric watch clock.
7. Every officer and agent of all insurance companies, and every practical person who has ever examined this clock, invariably approves and endorses it over all others.



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An Electric Watchman's Clock operated by a Magneto Generator at each station, each independent of the other, infringes the right secured to this Company by the above patents, and renders each individual user of Magneto Watch Clocks not furnished or licensed by this Company, responsible for such unlawful use, and liable to suit therefor.

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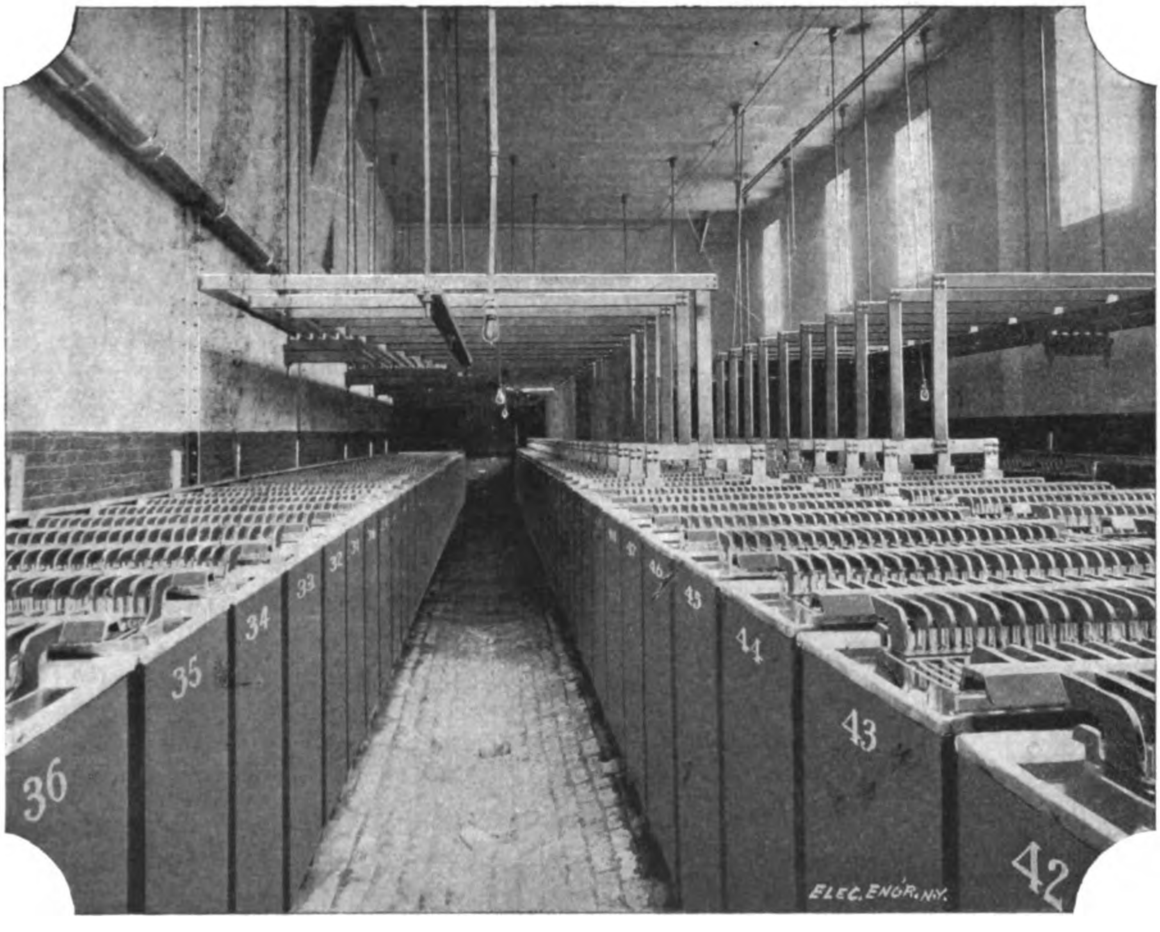

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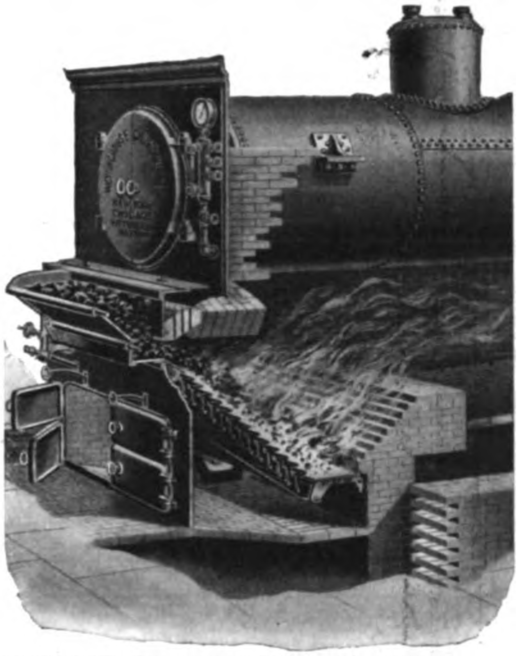

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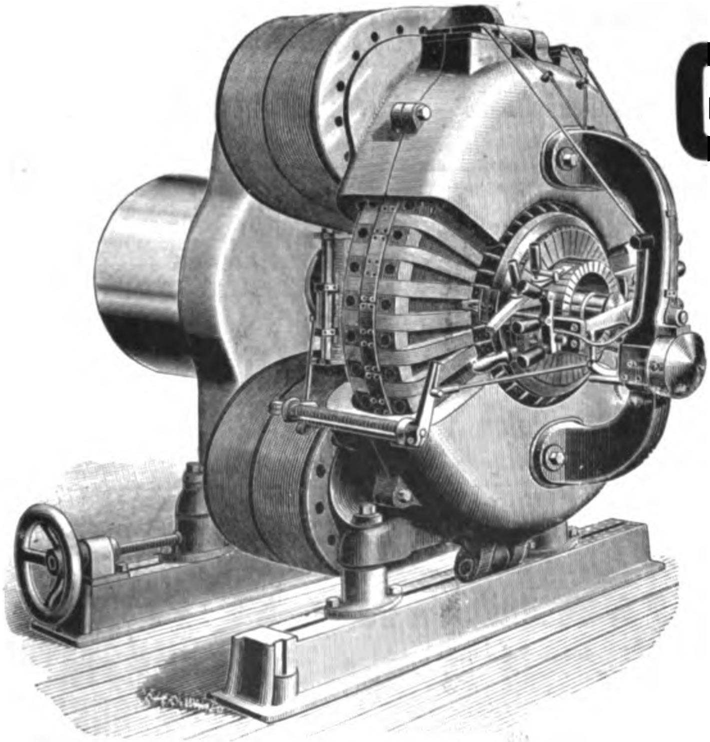

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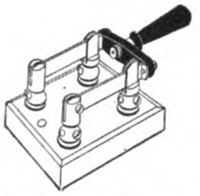

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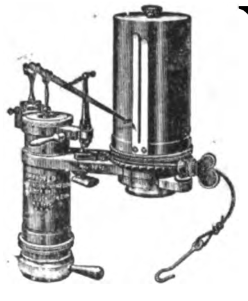

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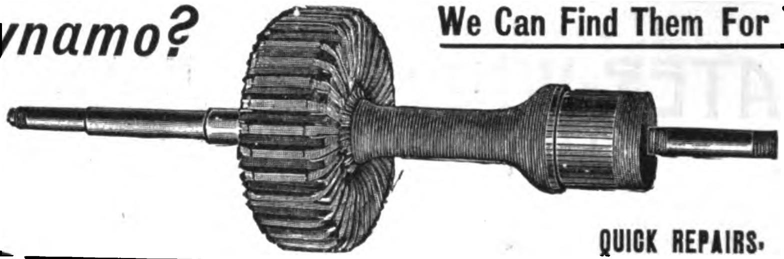

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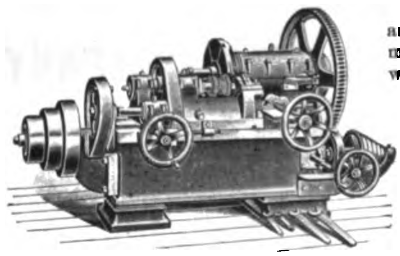

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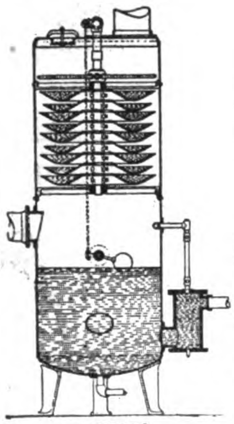

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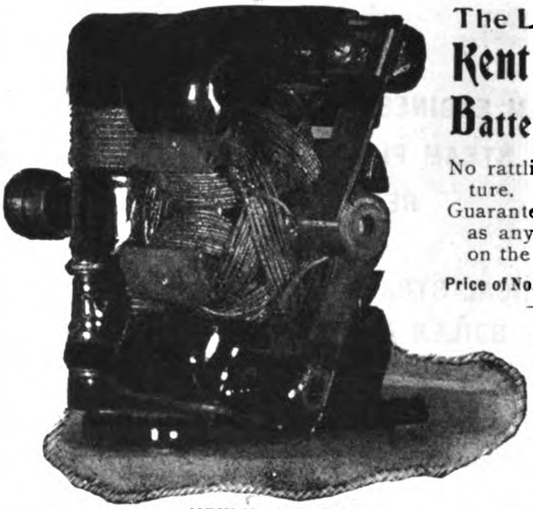

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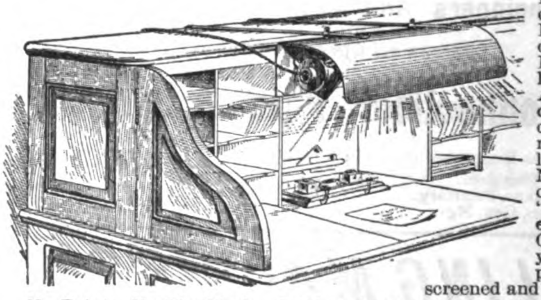

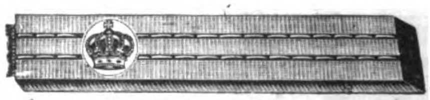

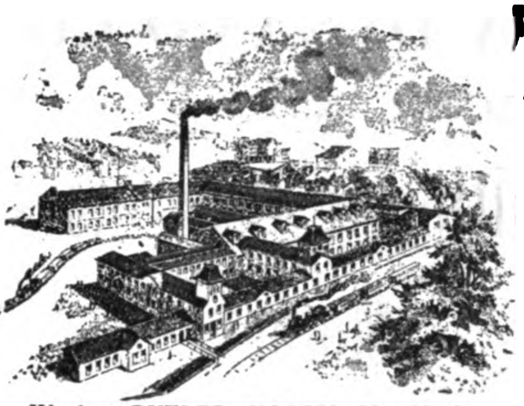

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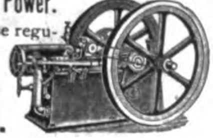

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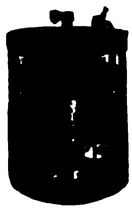

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Extracts from paper read before Electrical Section of the Franklin Institute, by Walter E. Harrington, General Manager Camden and Suburban Railway.

"The use of the Edison-Brown Amalgam to improve the contacts of copper bonds showed some very interesting results.

"Used with the Crown bond manufactured by the Washburn & Moen Company, it showed a decrease of 24 per cent. in the resistance by amalgamation."***

"The resistance of such a bond (the Bryan bond) without the Edison-Brown alloy is *very high;* comparing it with two Crown bonds non-amalgamated shows a resistance 146 per cent. higher, but the AMALGAMATION MAKES A REMARKABLE DIFFERENCE.

"Comparing it with the non-amalgamated Crown bond makes a difference of just 42 per cent. in favor of the Bryan (when amalgamated), whereas with two Crown bonds, amalgamated, makes a lesser difference of 23 per cent. in favor of the Bryan bond amalgamated, with a still further advantage of permanency."

"The great objection to the Crown and Columbia, etc., type of bonds consists chiefly in the mechanical defects inherent in them. The vibration of the rail, with the play of the rail joint, results in a continual stress upon the small area of the contact, followed by the final loosening of the bond.

"The writer has removed bonds of the above types which had been in service only a couple of years, that had become loose and the continual movement had worn the bond approximately ⅛ inch smaller in diameter in places.

"The Bryan bond and those types which are flexible, and particularly the Edison-Brown type, are free from such mechanical defects.

"While it was not the purpose of the writer to make tests herein outlined to demonstrate the virtues of the Edison-Brown Bond, still the results were so pronounced that especial stress is laid upon them particularly SINCE PRACTICAL EXPERIENCE HAS DEMONSTRATED THEIR PERMANENCY. It will be noticed that the 'Plastic Cork' type of the Edison-Brown Bond gave the lowest resistance of any of the bonds tested.

"Conclusions.—THE EDISON-BROWN PLASTIC BOND IS THE BEST."

TABULATION OF MR. HARRINGTON'S TESTS.

KIND OF BOND	Ohms	% Res = A/B	Current Carrying Capacity Without Heating	Center to center of contacts	Length of Bond	Size of Contact	B. & S. Gauge	Number of wires in bond
Joint Only—No Bond	.00071		15 amperes	36 inches				
Iron Channel Pin	.00049	69 %	36 "	45 "	48 inches	9/16-inch pin	0	1
Bryan-Iron Wire	.000286	40 %	161 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	⅛ inch	2
Crown	.000247	34 %	46 "	30 "	36 "	⅞-inch head	0000	1
Bryan-Iron Wire (Amalgamated)	.000224	31 %	210 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	⅛ inch	2
Crown (Amalgamated)	.000185	25 %	386 "	30 "	38 "	⅞-inch head	0000	1
Bryan-Copper Wire	.000175	24 %	161 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	0000	2
Columbia	.000131	18 %	170 "	30 "	36 "	⅞-inch head	0000	1
Columbia (Amalgamated)	.000126	17 %	161 "	30 "	38 "	⅞-inch head	0000	1
Stranded Crown	.0001	14 %	400 "	5 "	7 "	⅞-inch head	0000	1
Plastic Socket	.000093	13 %	1030 "	3¼ "	4¼ "	One square inch	000	
Bryan-Copper Wire (Amalgamated)	.000071	9 %	1200 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	0000	2
Plastic Cork, Under One Angle Plate Only	.00006	8 %		9 "		Surface 1¼ deep		
Plastic Cork, Under Both Angle Plates	.00008	4 %	2400 "	9 "		Two square inches	6 0000	
Solid Rail—No Joint	.000013		1200 "		18 "	Four square inches There were holes in web.	12 0000	

· TESTS MADE ON PENNA. STEEL CO. 7 INCH GIRDER RAIL, NO. 238. (A=Resistance of Bond. B=Resistance of Joint only).

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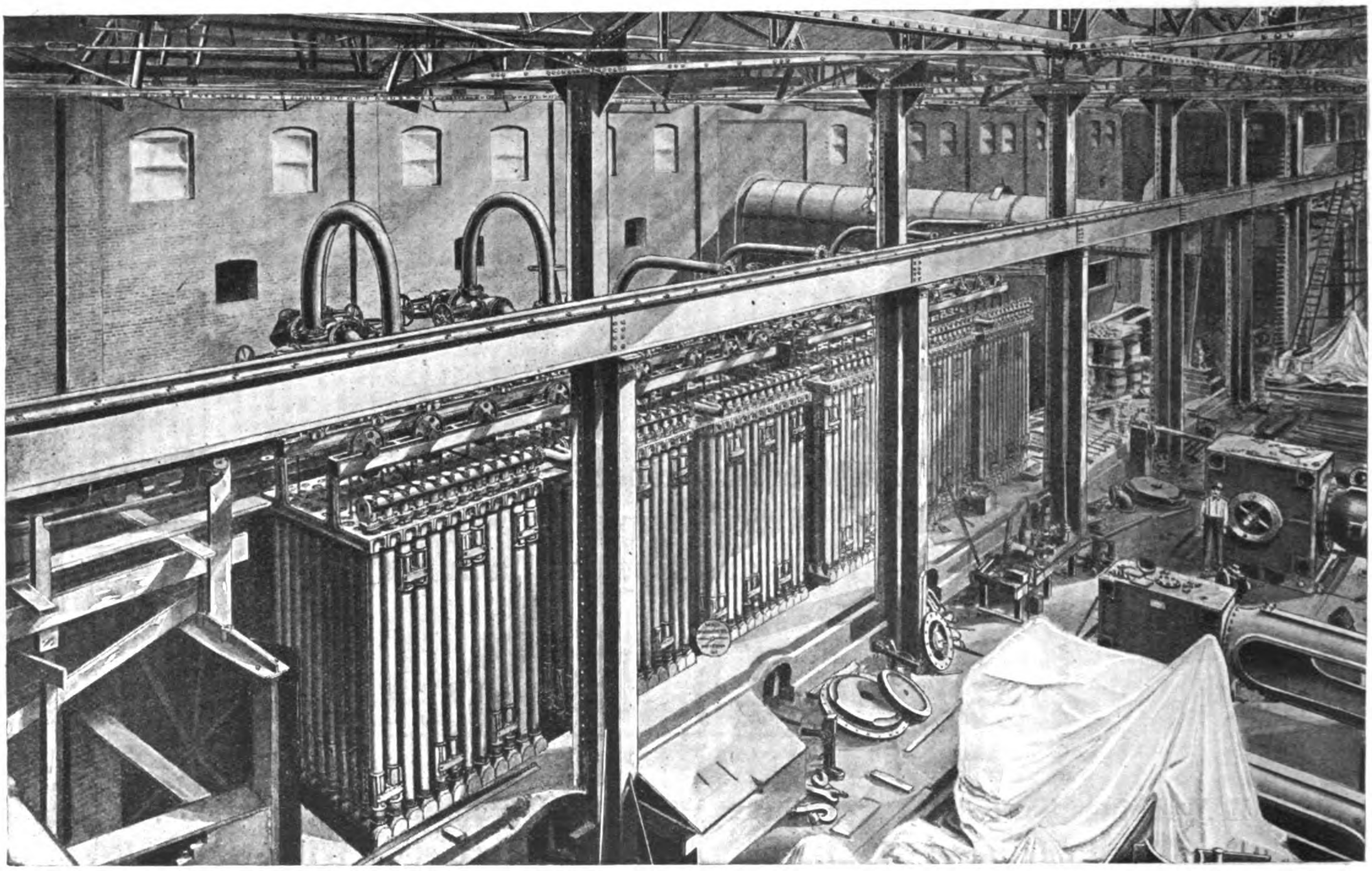

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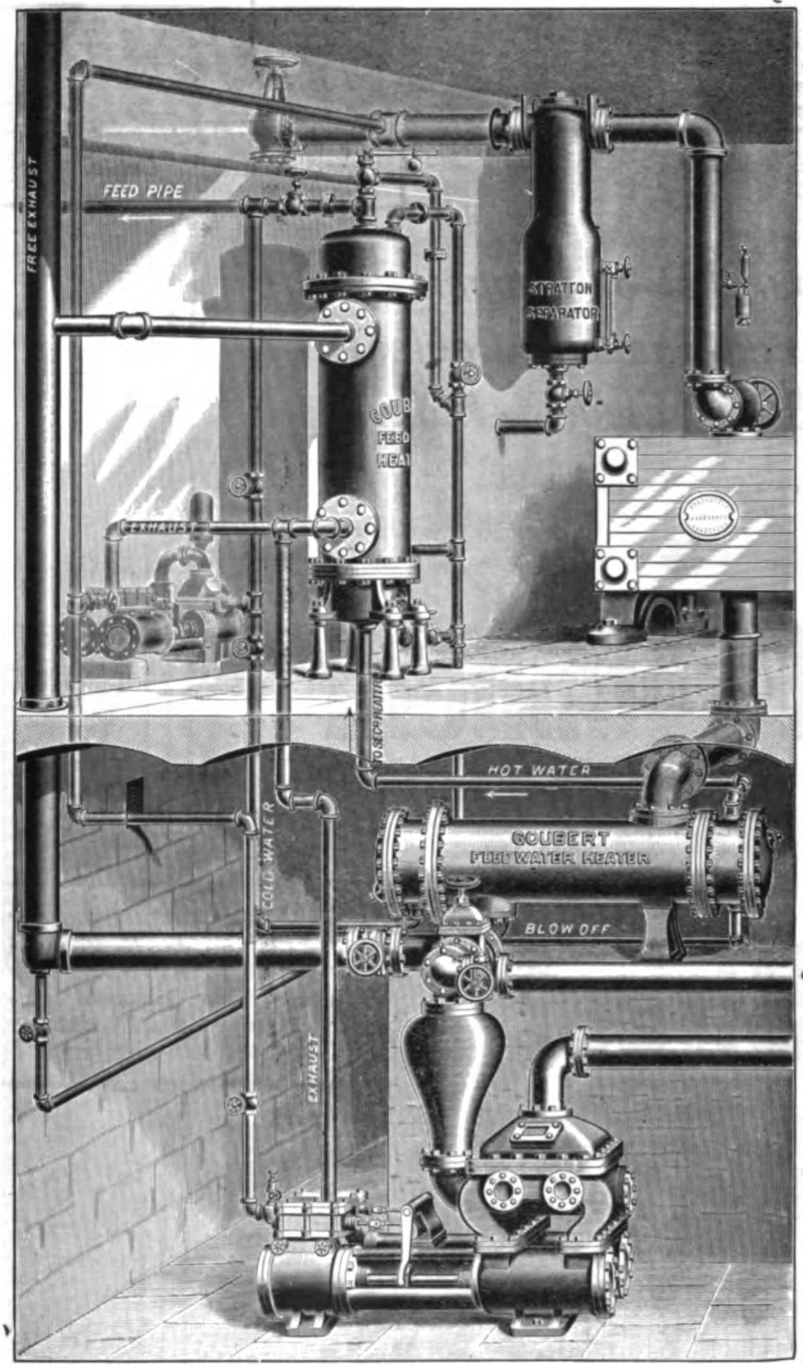

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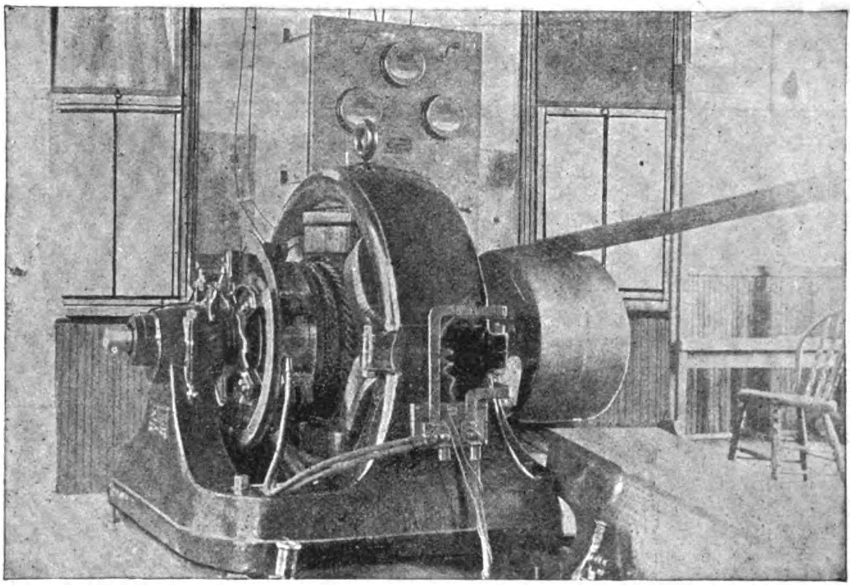

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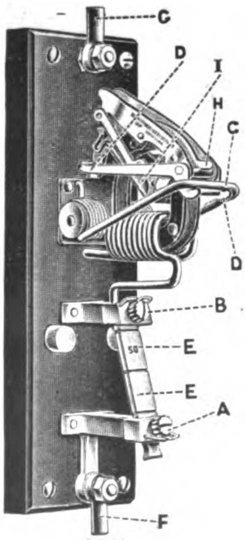

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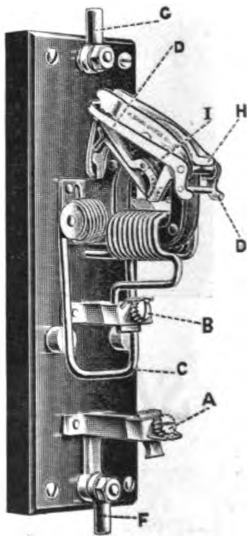

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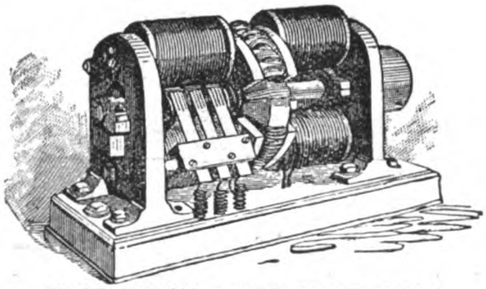

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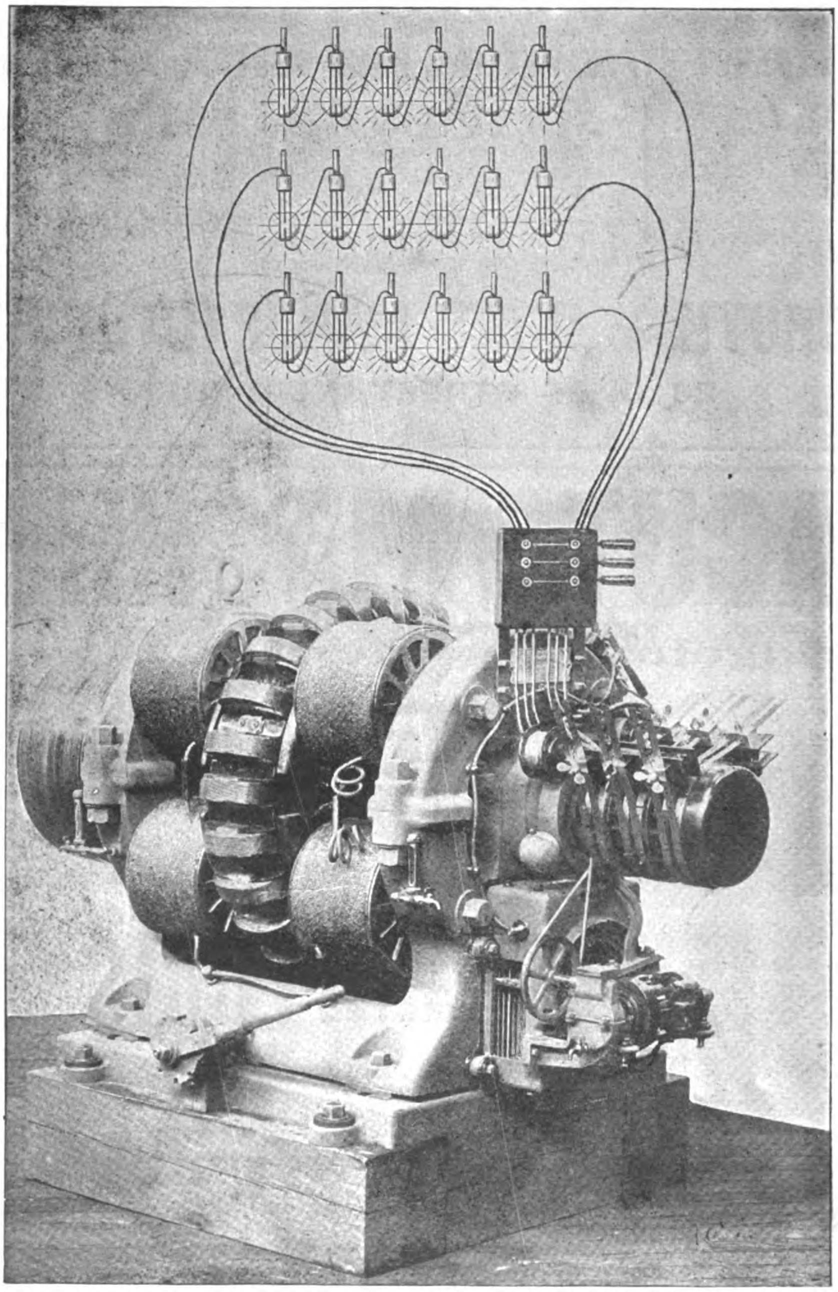

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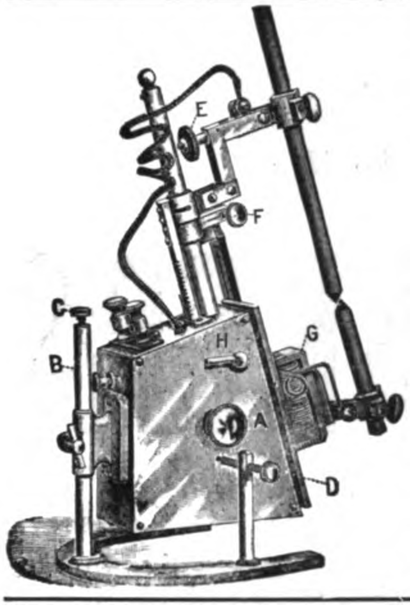

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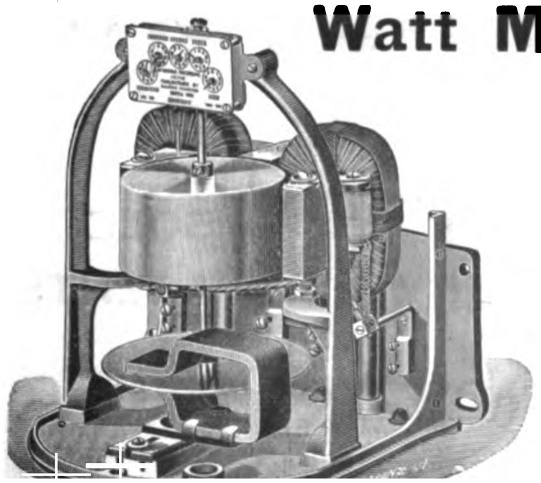

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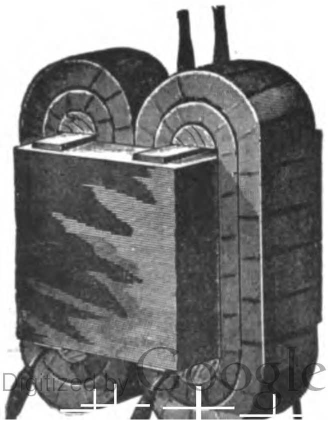

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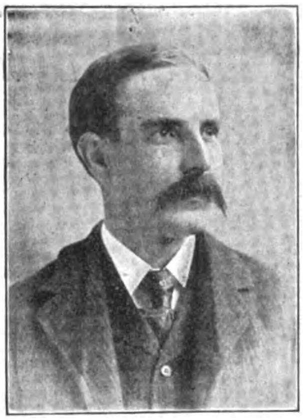

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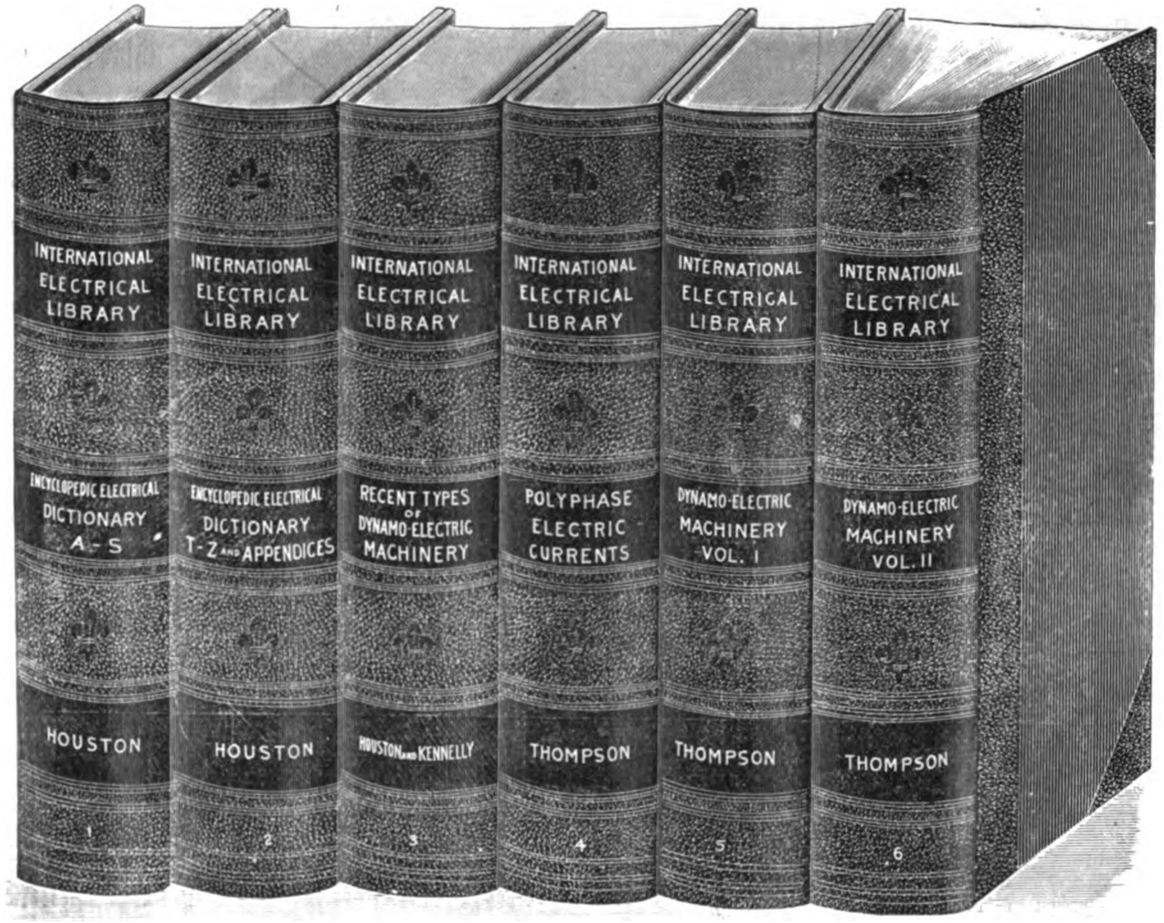

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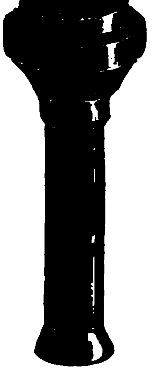

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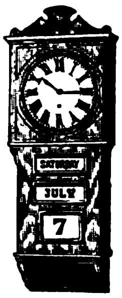

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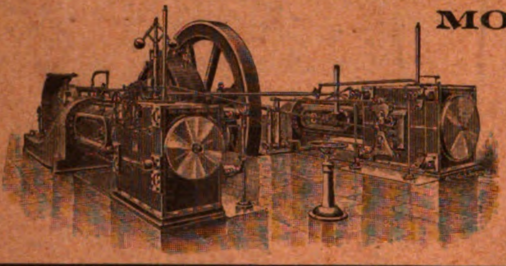

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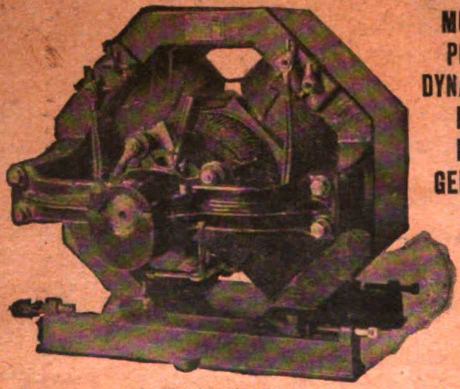

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